Vol. 91, No. 10 New York, March 10, 1928 *Pages 491-540*

L. W. W. MORROW
Managing Editor
EARL WHITEHORNE
Commercial Editor
ALLEN M. PERRY
Associate Editor
G. F. WITTIG
Statistical Editor
H. M. CAMERON
Financial Editor
F. C. WELLS
News Editor
EUSTACE C. SOARES
Manufacturing and Markets Editor

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

W. H. ONKEN, JR., *Editor*

FRANK R. INNES and T. P. KINDIG
Western Editors
7 South Dearborn St., Chicago

H. S. KNOWLTON
New England Editor
88 Tremont St., Boston

WALTER C. HERTON
Pacific Coast Editor
883 Mission St., San Francisco

E. B. SEARLES
Assistant Editor

PAUL WOOTON
Washington Correspondent
National Press Bldg., Washington

Contents of This Issue

EDITORIALS 491

Frontispiece—A HYDRO-ELECTRIC PLANT ON STILTS....494

220-KV. CARRIER-TELEPHONY 495
By Roy B. Ashbrook and Ralph E. Henry
Southern California Edison Company installation covers 270 miles of 220-kv. transmission line. Single-frequency duplex system with selective ringing used.

ICE PREVENTED ALONG SPILLWAY BY COMPRESSED AIR..498
By F. A. Dale

SIMPLIFIED DISTRIBUTION PLANNING.....499
By W. R. Bullard
Methods of calculating the economic characteristics of electrical distribution systems, particularly transformer spacing and sizes of line conductor.

TRANSFORMERS ON UPPER AND LOWER FLOORS SAVE COPPER 504
By T. W. Swartz

SERVICE RESTORATION EXPEDITED.....505
By J. E. Shalter
A detailed account of how service or trouble dispatching is organized and handled by the Metropolitan Edison Company.

HINGED PANELS REDUCE SPACE REQUIREMENTS.....507

SELF-CONTAINED 25-KV. METERING EQUIPMENT.....507

PROTECTING GENERATOR FIELDS AGAINST OVERVOLTAGE..508
By R. B. Greenwood

ELECTRIC LOCOMOTIVES OPERATED IN 1 FT. OF WATER...508

OPPOSES CONTRACT TO REGULATE.....509
Companies declare constitutional rights threatened by abolition of court appeal. Economic weakness of proposal put forth by counsel for companies.

MEASURING INFINITESIMAL ELONGATION ELECTRICALLY.511

RANGE-SERVICING COSTS MOUNT UNDER FREE MAINTENANCE 512
By D. F. McCurrach

OPERATING COSTS FOR WHITE-WAY LIGHTING.....512

ARC WELDING FOR MACHINERY.....513
By A. F. Davis
An analysis of the underlying factors governing the use of arc welding, with some examples of cost comparison with cast iron.

CHARACTERISTICS OF INDUSTRIAL LOADS.....515

UTILITY FINDS OPPORTUNITIES FOR ECONOMIES IN MANY DEPARTMENTS 517

LETTERS FROM OUR READERS.....517

DIGEST OF ELECTRICAL LITERATURE.....518

BOOK REVIEWS 520

NEWS OF THE INDUSTRY.....521

COURT DECISIONS, COMMISSION RULINGS.....528
MEN OF THE INDUSTRY.....529
FINANCIAL AND STATISTICAL.....530
BUSINESS NEWS AND MARKET CONDITIONS.....535
NEW EQUIPMENT AVAILABLE.....539
ELECTRICAL PATENTS 540

What a Manufacturer Thinks of It.

"FOR the past 30 days we have been using, in connection with our sales planning for the coming year, parts of the information contained in your Jan. 7 issue. We think the ELECTRICAL WORLD is a fine publication."

This incidental comment in a letter from the district manager of one of the branch offices of a prominent manufacturer is typical of others that have come to us verbally or in writing. One of the reasons why leaders in the industry lead is because they have learned to analyze and use statistics. Progress is made by co-operation; in the gathering and disseminating of information the industry journal serves as the co-ordinating agency.

McGRAW-HILL PUBLISHING COMPANY, INC.
Tenth Ave. at 36th St., NEW YORK, N. Y.

JAMES H. McGRAW, President
JAMES H. McGRAW, JR., V.-Pres. and Treas.
MALCOLM MUIR, Vice-President
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
C. H. THOMPSON, Secretary

NEW YORK Dist. Office, 285 Madison Ave.
WASHINGTON, National Press Bldg.
CHICAGO, 7 South Dearborn St.
PHILADELPHIA, 1600 Arch St.
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie Street, London, E. C. 4

Cable Address "Machinist, N. Y."

The annual subscription rate is $5 in the United States, Canada, Mexico, Alaska, Hawaii, Philippines, Porto Rico, Canal Zone, Honduras, Cuba, Nicaragua, Peru, Colombia, Bolivia, Dominican Republic, Panama, El Salvador, Argentina, Brazil, Spain, Uruguay, Costa Rica, Ecuador, Guatemala, Haiti and Paraguay. Extra foreign postage, $4 (total $9 or 38 shillings). Subscriptions may be sent to the New York office or to the London office. Single copies, postage prepaid to any part of the world, 25 cents.

Change of Address — When change of address is ordered the *new* and the *old* address must be given. Notice must be received at least ten days before the change takes place.

Publishers of
Engineering News-Record — American Machinist
Power — Chemical and Metallurgical Engineering
Coal Age — Engineering and Mining Journal
Electrical Merchandising
Ingeniería Internacional — Electric Railway Journal
Bus Transportation — Construction Methods
Electrical World — Radio Retailing
Electrical West
(Published in San Francisco)
American Machinist—European Edition
Published in London

Copyright 1928
By McGraw-Hill Publishing Company, Inc.

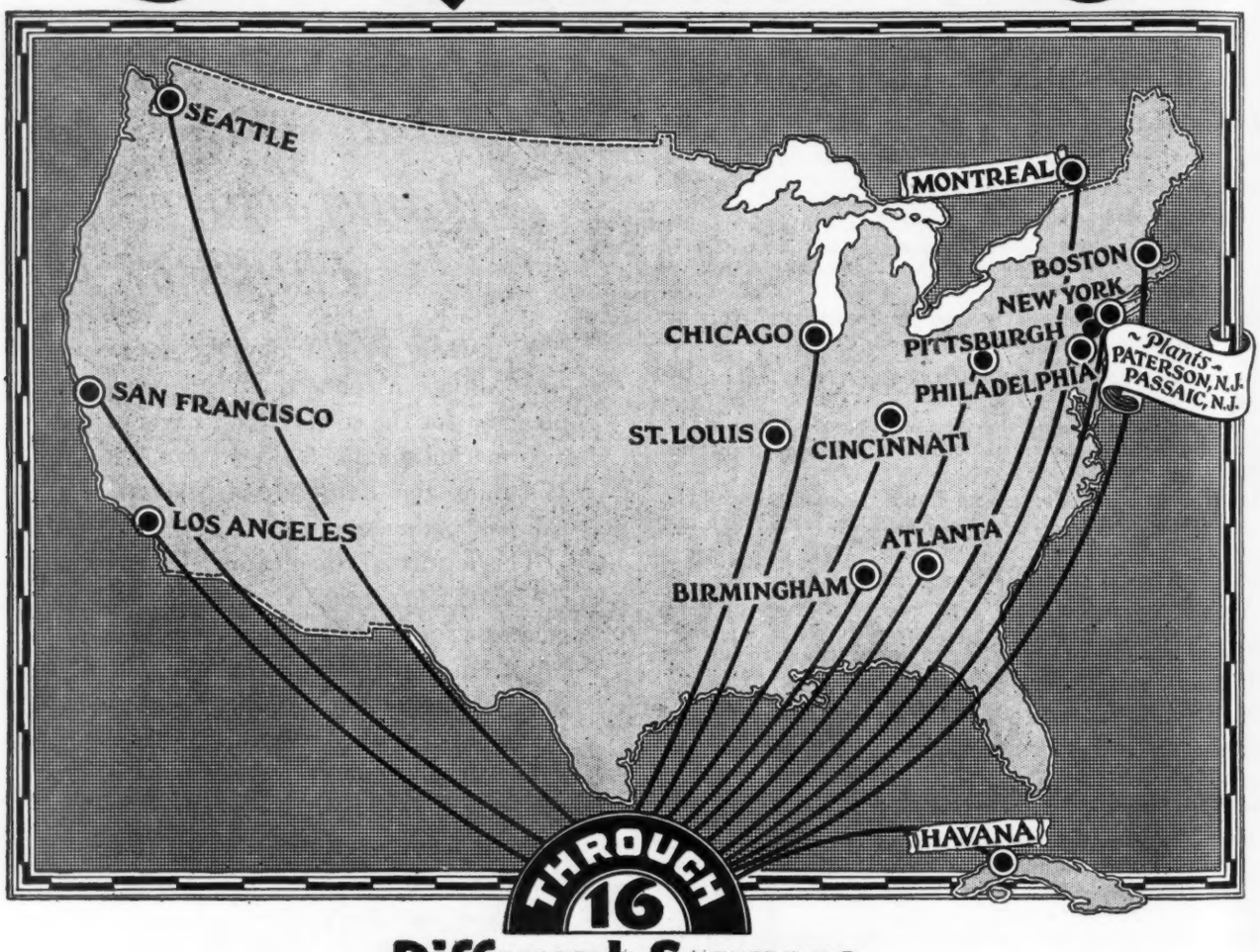
Published weekly
Entered as second-class matter Jan. 20, 1907, at the Post Office at New York, N. Y., under the Act of March 3, 1879.
Printed in U. S. A.

Circulation of this issue, 19,550

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

Advertising Index—Alphabetical, 92; Classified, 86, 88, 90; Directory of Engineers, 50, 51; Searchlight Section, 52-57

you can obtain OKONITE QUALITY



Different Sources

OKONITE rubber and varnished cambric wires and cables and OKONITE-CALLENDER impregnated paper cables are used *throughout* the United States. It is logical, therefore, that these products should be made available through some sixteen different points—each the center of a district where large quantities are used.

There are, in other words, no weak points in OKONITE insulation and no weak points in our chain of distribution. We try to render sales and engineering service in every way worthy of the service rendered by our products during the last fifty years.

We invite you to get in touch with our nearest office in order to obtain a sample of this service together with a sample of the wire or cable that you find best suited to your needs.

OKONITE

The Okonite Company

The Okonite-Callender Cable Company, Inc.

Factories: PASSAIC, N. J. PATERSON, N. J.

SALES OFFICES: NEW YORK CHICAGO PITTSBURGH ST. LOUIS ATLANTA
BIRMINGHAM SAN FRANCISCO LOS ANGELES SEATTLE
Pettingell-Andrews Co., Boston, Mass. Novelty Electric Co., Philadelphia, Pa.
F. D. Lawrence Electric Co., Cincinnati, O.

Canadian Representatives: Engineering Materials Limited, Montreal
Cuban Representatives: Victor G. Mendoza Co., Havana

OKONITE

Electrical World

Published by McGraw-Hill Publishing Company, Inc.
W. H. ONKEN, JR.
Editor

VOLUME 91 — *New York, Saturday, March 10, 1928* — NUMBER 10

Limited Dividends

THE president of the American Telephone & Telegraph Company, Walter S. Gifford, has announced a definite policy of no further increase in dividend rate on the common stock of the world's largest public utility. In adopting this policy he said to stockholders:

"Earnings must, of course, be sufficient to permit the best possible telephone service at all times and to provide a reasonable payment to stockholders with an adequate margin to insure financial safety. Earnings in excess of these requirements will either be spent for the enlargement and improvement of the service furnished or the rates charged for the service reduced. This is the fundamental in the policy of the management."

If the earnings are limited through voluntary rate reductions or adjustments, a stabilizing factor is introduced. This is not a new thought for utility men but is unusual because it has been applied by such a large company. Several chief executives of electric light and power utilities have succeeded in inaugurating a similar policy in their organizations, and possibly more will find it advantageous to follow these examples. The telephone company and the electric light and power industry are outgrowing the speculative age and, as befits the maturity of their development, are settling down to the task of supplying to their customers the fundamental thing that they have to sell—service.

* * * *

Apologia Is Not Advertising

THE man on the curb is not favorably impressed with public utility advertising that resorts to either apologia or braggadocio. Neither appeals to the public. Apologia is not advertising. In the public prints it excites suspicion. "What have these people been up to that they thus sprinkle themselves with sweet perfume?" asks the cynical "Vox Pop." And if he happens to remember his high-school excursions into the classics of our tongue he may add: " 'Methinks the lady doth protest too much' !" Braggadocio is even worse. To publish encomiums on one's own courage, integrity, vision, leadership, consummate skill, unfailing efficiency and splendid zeal arouses not admiration but a species of pity. Men in whom these attributes are inherent do not openly advertise them.

Unquestionably good-will advertising designed to checkmate action which might result in any degree of nationalization of the electric light and power industry is desirable and important. Certainly something should be done to preserve the industry from becoming a political football. But boasting, apologizing and reiterating the high-sounding phrase "freedom of individual initiative" is a wrong and harmful way to go about it. A better way is to tell the public in direct, vigorous and persuasive advertising of the almost miraculous advantages of electric service—in other words, to sell the electric idea. Broadly, this has never been done. It should be done now. When the public are made truly conscious of the blessings which accrue to them from electric service they can be relied upon to protect the source of that service.

* * * *

Temperance and Conciliation Needed in the Bay State

BAY STATE power companies are under heavy fire on Beacon Hill. The Department of Public Utilities is seeking a guarantee of continued regulation of these properties through company assent to a proposed legislative act which industry leaders assert would abrogate their constitutional rights—guarantee, because the board fears that if the United States Supreme Court should sustain the reproduction-cost rate base on final appeal of the Worcester Electric Light or any other company, regulation in Massachusetts would become a hissing and a byword.

The Worcester appeal to the federal courts apparently brought this matter to a head, although the chairman of the commission maintains that the proposal has been under more or less open consideration for several years and that the board is actuated by a desire to safeguard the consumer against possible exploitation in the form of increased rates on properties lately acquired by nonresidents of the state. This Banquo ghost of rate increases leers horribly across the commission's table, but it is bound to fade from sight when the daylight of promotional rate successes in other jurisdictions sweeps away the shadows of flat-rate limitations from the council chamber of this hard-working but overanxious tribunal.

We do not believe that regulation in Massachusetts is in desperate case because a single company is exercising its legal rights in asking the courts to pass upon the fairness of a commission decision. The Worcester company's rate and dividend policies have been both criticised and defended within the industry itself; but do this and other rate situations in the Bay State call for such a remedy as nullifying the constitutional right of court appeal by signing it away virtually at the point of a pistol? It is difficult to believe that the Massachusetts Legislature will enact such a measure into law at this time, in view of its many objectionable features, including its questionable economic soundness, its dubious effect upon credit and investment values, its threatened impairment of surplus and its repugnant requirement of contract under duress.

Despite confidence that ultimately the situation will be adjusted, just now it is not a pleasant one. Bickering and strife lead nowhere but to confusion, and there is need for some one to take the commission and the

utilities by the hand and say, "Come now and let us reason together." Certainly, our highest court does not "promote greed and gluttony," and one who contends for his legal rights is not a "hog." A little more tolerance and consideration on the part of both the commission and the utilities will lead to understanding and to a way out. The issue is too serious and the consequences of hasty action are too great to be decided in any other way. The Commonwealth of Massachusetts, we are sure, does not seek to confiscate property or to deal unjustly with public utility corporations. It has not done so in the past and has hardly become socialistic now. Neither do the utilities, if they are wisely managed, seek to charge rates out of all proportion to the value of the service. What differences exist should be quickly adjusted and composed in keeping with the spirit of regulatory law and to the mutual advantage of consumer and producer.

* * * *

Research Not Foreign to Operation

IMAGINATION allowed to run rampant may seldom be productive of anything commercially applicable, but who can say this of directed, logical speculation on the course that electrical development will take? Successful research requires physicists with imagination. Business is demanding sales managers with imagination to develop new markets. Then why should not every one in a field as fertile for development as electrical engineering stimulate and exercise his imagination? This is particularly needed because of the advances which are being made in electron control—a phenomenon not confined to radio communication by any means. Virtually every electrical problem with which light and power companies are trying to cope involves electron control.

Manufacturers' engineers who are in close touch with research laboratories are not likely to overlook the visualization of ways in which scientific developments may modify present methods of production, transmission and control of electrical energy. But the practical-minded operators of electrical systems are not prone to speculate. As a consequence they may extend systems in such a manner that it will be very costly to adapt them to new and desirable discoveries. If the operators who think in terms of economy and the practical needs of their companies would delve into the results of research occasionally, perhaps they could suggest to manufacturers ways in which present physical knowledge could be combined to serve commercial needs even more than now. At least such studies would prepare them to handle power applications of electron control knowingly when they arise.

For example, who can say that we may not have an electron control device some day that will combine a power rectifier and circuit breaker for feeding Edison systems? Research pointing in this direction has been reported. Again, with a d.c.-a.c. tube working on the electron-control principle and delivering alternating current of adjustable frequency, the speed of ordinary induction motors could be gradually raised from zero to maximum without loss of torque and without complexity of control, opening the field for direct-current transmission and simple motor and control apparatus if they are desirable for train operation. Since arcs involve the discharge of electrons from one conductor to another and since research indicates that electrons can be controlled, would it be unreasonable to expect that entirely different insulators might be developed?

These dreams are just indicative of others that may materialize into commercial realities if engineers outside laboratories and manufacturing plants will study research results and add their ideas to those of the manufacturers and scientific workers.

* * * *

"Shoestring" Tie-ins Challenge Engineering Analysis

BETWEEN many adjacent utility systems are interconnections whose usefulness is taken for granted when there should be a rigorous inquiry into their justification. A vast difference exists between low-capacity frontier contacts and intersystem ties or interstation trunks that serve for transfer of substantial blocks of energy. In many cases the limitations of low-capacity tie lines are so great that they cut virtually no figure in regional operations. Sometimes they actually prevent territorial load dispatching along the high-grade lines now regarded as standard practice.

Such ineffective "shoestring" tie-ins should be checked regularly by engineering departments and a program outlined providing for their retention, their future development or their abandonment for salvage. The substitution of interplant and intersubstation trunks for such lines has been effective in some quarters in providing adequate channels for transfer of energy and improvement of service continuity and voltage regulation.

* * * *

High-Frequency Freaks

ONE of the byproducts of the development of high-frequency equipment for radio transmission, and particularly of the recent tendency to shorter waves and higher frequencies, is the interest aroused in many unusual and striking physical, chemical and biological effects of high-frequency electric fields. The general character of these effects has been known for many years and was emphasized by the experiments of Sir Oliver Lodge and Tesla, not to mention numbers of others. As the equipment of these early investigators was usually of limited capacity, the amounts of energy associated with the high-frequency phenomena were small and their application was limited to laboratory demonstrations and therapeutic effects.

However, the development of the electron tube has afforded a high-frequency generator of high capacity, and recent reports from the General Electric research laboratories refer to a 15-kw. oscillating tube and circuit in which the energy is radiated into space from a copper bar a few feet long and at frequencies of the order of fifty million cycles per second. This equipment is remarkable and noteworthy because of its high rating and the extreme concentration of energy radiation in the neighborhood of the short antenna. It will undoubtedly be a powerful instrument for the study and development of short-wave radio transmission.

Very striking results are reported from the electrical disturbances caused in proximity to the tube, and particularly such phenomena as standing unipolar electric arcs, the cooking of food and the warming of the blood of persons standing near by. It is suggested that the last-named phenomena may have a useful medical and therapeutic value. It is interesting to note that the phe-

nomenon of high-frequency fields warming the blood was apparently first noted by Wood and Loomis and reported in the *Philosophical Magazine* for September, 1927, using similar equipment and frequencies in the neighborhood of a hundred million cycles, but of very much lower rated output. It is possible that some of the other manifestations of concentrated radio energy may find useful application.

* * * *

Appliance Servicing an Obligation— But Whose Responsibility?

NO CENTRAL-STATION company, regardless of how energetically it merchandises appliances, expects or wants to do all the selling in its territory. In fact, utility companies welcome other dealers and hope to see their sales volume grow. What the central-station companies do not like to see is the failure of dealers in their territory for whatever reason. Such failures act as a damper on all appliance selling. As servicing seems to be the rock upon which many dealers founder, would it not be good business for the central-station companies to act in a standby capacity in this matter of servicing?

If a local power company lets its customers know it can be depended upon to keep their electrical appliances in operation, it will greatly increase the confidence of prospective purchasers. Many companies are already tacitly doing this. The Detroit Edison Company, has organized service departments which answer trouble calls and make repairs on all household appliances regardless of where these were purchased. Such a service need not be extended to substandard equipment. This practice would automatically discourage the sale of devices of questionable merit. It would give the central-station company more effective supervision of the kind of appliances being sold to its customers. It would encourage the responsible dealer to know that he had the local utility company back of him. It should encourage the manufacturer to make a device requiring a minimum of service.

Whether or not and how servicing is to be charged for, it appears that the electrical industry eventually will be obliged to assume the major part of the responsibility. If this responsibility and control were centered in one place — the electric utilities — it would be a long step forward in stabilizing the electric appliance business and reducing the cost of individual services.

* * * *

Greenwood's Appointment Is Good News

THERE is good promise in the appointment of C. Ernest Greenwood as commercial director of the National Electric Light Association. After more than a year of discussion and deliberation, the job has found the man. It was a difficult place to fill. It needs a man who understands the N.E.L.A. and how it works and can establish leadership in harmony with traditions and established practices. Greenwood has had years of active committee work for background. It needs a man who can help carry forward the two pressing commercial objectives that are at the forefront at the moment—the adequate wiring of homes and the development of better trade relations. For, to speed the building of domestic load, facilities must be provided for the use of more appliances in the 17,600,000 incompletely equipped wired homes and for a more effective flow of electrical merchandise into those homes from all the natural neighborhood sources of household supply—department stores, hardware stores, drug stores, as well as electric shops and central-station salesrooms. Greenwood has led the recent movement for better understanding and co-operation between the trades and as chairman of the N.E.L.A. Commercial Section merchandising committee and head of the appliance department of the Boston Edison company has had appropriate training. Fortunately, in Boston he also for a time was in charge of negotiations for service to new buildings and isolated plants, and prior to that he served in the statistical department in rate analysis problems. His experience is, therefore, well rounded and comprehensive.

The establishment of a commercial director at N.E.L.A. headquarters is just another sign of the quickening interest of the industry in the importance of the sales function. It should greatly strengthen and accelerate the work of the Commercial Section, because it will bring continuity of effort to committee activities and the co-ordination of purpose that is only possible when some one with responsibility and initiative carries on from year to year.

* * * *

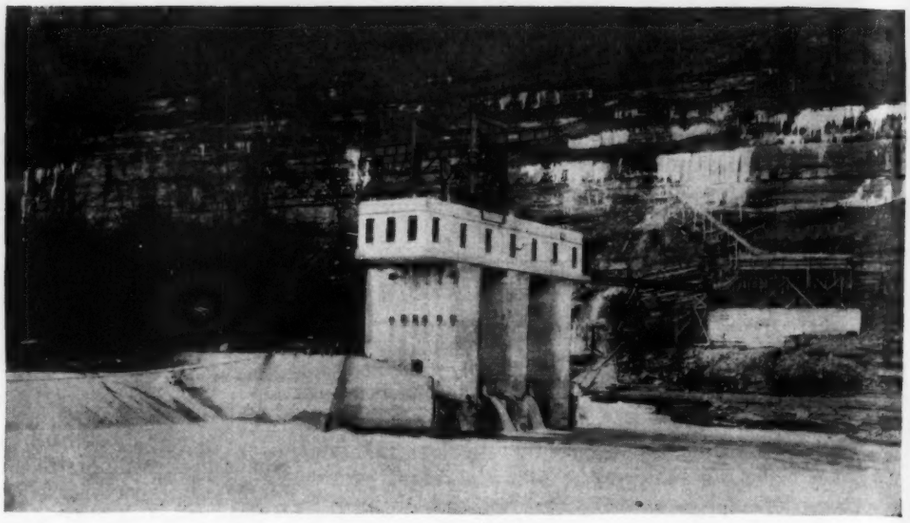
"Totin' Together"

"TOTIN' TOGETHER" means carrying the load together, each one doing his share of the job. Just as it is possible for one man to slack off and make his team mate do more, so is it possible for one of two interconnected electric systems to shirk its portion of the mutual service responsibility. Manifestly it is impossible to cover in an interconnection contract all of the operating conditions that may arise. Any attempt to do so would result only in a contract that would fail in its purpose because of complexity. Unless an interconnection contract represents an agreement between two or more systems that will voluntarily "tote" the load together, the contract is hardly worth the paper it requires. Without this attitude there are plenty of ways in which the spirit of the contract may be encroached upon without transgression of the letter.

Interconnections might better be dissolved than to have the parties to them observe only the letter of the law. For example, what value would written agreements have if, because relay settings were not mentioned, relays were adjusted by one party to free itself of entangling alliances when trouble occurred on the connected company's lines? It would not compensate for failure to give relief merely to express regrets because the system broke loose or to protest most strenuously that the cause of the separation was a mystery. Just because meters at an interconnection point are not equipped with ratchet registers one party is not warranted in trying to trade back off-peak energy for on-peak kilowatt-hours. A few such evasions of moral obligation have regrettably occurred and probably will arise again, but they are not in keeping with the spirit of interconnection.

With all the opportunities for evading written agreements, which an ingenious mind may devise, it is almost futile to guard against them in interconnection contracts. The full benefits of interconnection are more liable to be realized if two systems will join hands with the simple statement that they will be square with each other and will work out their common problems in a spirit of fair play.

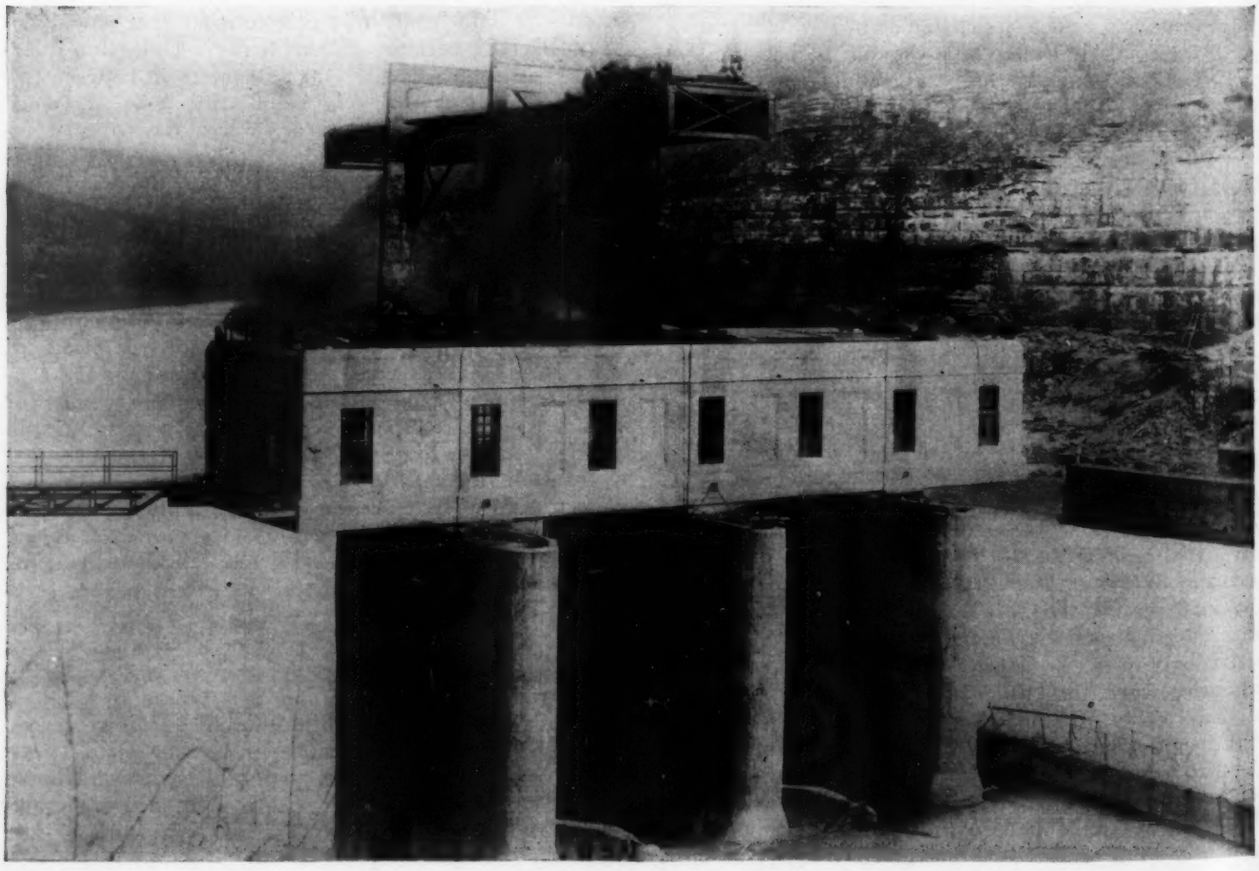
A Hydro-Electric Plant on Stilts



THIS unusual plant, shortly to be completed for the Kentucky Hydro-Electric Company at High Bridge, Ky., was designed to comply with topographical conditions at Government Lock No. 7 on the Kentucky River. The valley is so narrow that there was not room for a plant beyond the end of the dam. Furthermore, the spillway could not be restricted because of the sudden and violent floods which occur.

In the lower part of the plant, over which floodwaters will flow, are the floodgates, draft tubes, etc. The generators and electrical control are in the upper section well above high water. The piers house the shafting and some auxiliary machinery. Equipment is handled through hatches in the roof by the outdoor crane. Transformers and switching equipment will be located on the left bank of the river and connected to the plant by a light foot bridge shown below at left of plant.

The equipment involves three 650-kw. generators driven by 150-r.p.m. propeller-type turbines, operating at a maximum head of 15 ft., and will be controlled from the Dix Dam power house, more than 3 miles away, by supervisory control.



220-Kv. Carrier-Telephony

Southern California Edison Company installation covers over 270 miles of 220-kv. transmission line. Single-frequency duplex system with selective ringing used

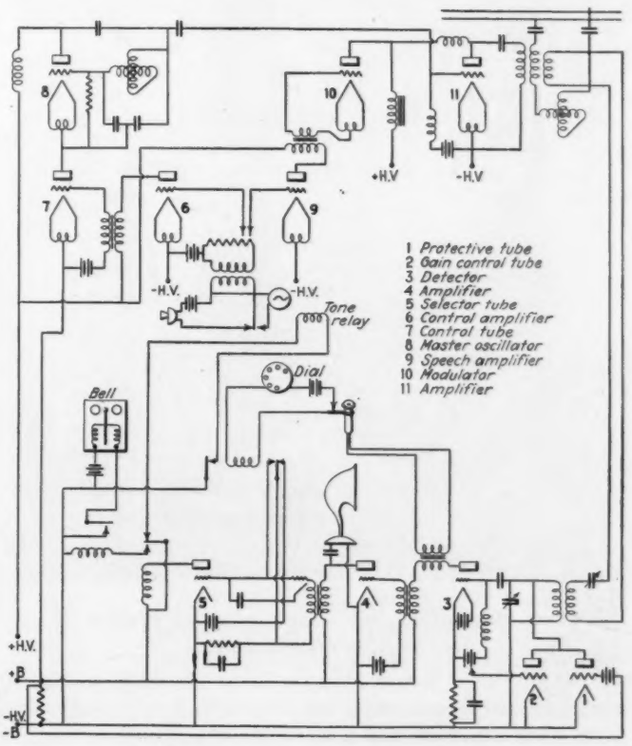
By Roy B. Ashbrook* and Ralph E. Henry†
Southern California Edison Company, Los Angeles, Cal.

POWER companies have followed with keen interest the rapid development of carrier-current telephony over transmission lines. Interest was further stimulated when the development reached the stage where many of the advantages of wire line communication could be enjoyed. Carrier-current equipment now permits of duplex operation, selective calling, full "party line" communication, wire line extensions and intersystem connections. The method of coupling the equipment to the transmission line has simplified the installation problem considerably; concentrated capacity coupling has marked advantages, in most cases, over the antenna type, and coupling condensers may be installed with the same degree of facility as power equipment. Installation of the radio-frequency line between the capacitors and the equipment has heretofore presented some difficulty at congested stations. This has been overcome by the development of tuning units which permit the use of lead-covered cable run underground. Thus the terminal equipment may be placed in the most advantageous location to meet operating requirements and station or office design limitations.

Having in view the many advantages offered by carrier-current telephony over transmission lines, and for the purpose of studying its operation to determine to what extent it would supplement wire line communication, the Southern California Edison Company placed two General Electric type CC3D sets in operation over its 220-kv. transmission lines. Installation was completed Oct. 1, 1926, and the circuit has been used continuously by the load dispatchers since that time. One set is installed at Big Creek power house No. 3 and the other at the Laguna Bell substation, the latter station being 270 miles from Big Creek and 15 miles from the Edison Building in Los Angeles. A type CC61 extension connects the primary carrier equipment at Laguna Bell to the load dispatcher's office in the Edison Building over a private open wire telephone line and gives the dispatcher remote control of the carrier equipment.

The primary carrier equipment is connected to the 220-kv. system through two General Electric 220-kv. oil-filled capacitors of 0.001 mfd. capacity each. The high side of these capacitors is connected directly to the "A" and "B" phases of the operating bus and the low side through suitable protective equipment to the primary sets. One of the accompanying illustrations shows the condenser coupling installation at Laguna Bell. The carrier equipment of Laguna Bell is temporarily installed in a small steel building approximately 300 ft. from the 220-kv. bus. The location of the capacitors with reference to the bus permits phase connections to be easily shifted. At Big Creek the equipment is installed in the emergency telephone house, some 250 ft. from the 220-kv. bus. The capacitors are connected to the bus in the same manner as those at Laguna Bell.

The primary equipment embodies what is known as "single-frequency" duplex operation with selective ringing." This single-frequency duplex operation can be explained as follows:



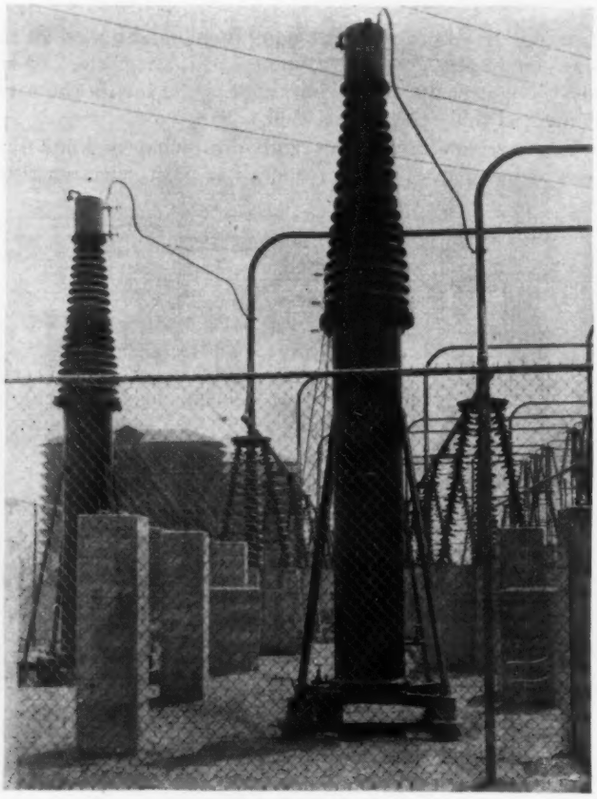
Condensers couple this carrier-current telephone equipment to 220,000-volt transmission line

If two stations are arranged to communicate by carrier-current telephony they may, by using different frequencies and each having a receiver tuned to the other's transmitting frequency, carry on a duplex, or two-way, conversation. That system would be called two-frequency duplex carrier-current telephony. With both stations tuned to the same frequency it is evident that the transmitter must be inoperative during reception and that the receiver be disconnected or otherwise protected from the transmitter during transmission. If this is accomplished by manual operation of a switch each time it is desired to change from transmitter to receiver the

*Communication engineer. †Department of engineering design.

service would be called single-frequency simplex carrier-current telephony. If by some means the transmitter could be caused to operate whenever an audio signal of sufficient intensity reached the microphone, and to cease to operate at the end of the audio signal, and if the receiver could be made operative at all times except when the local transmitter was actually operating, it would be possible to carry on a two-way conversation, as on any wire phone using one frequency. The system is called single-frequency duplex.

The outstanding advantage of the single-frequency duplex system is that a number of stations can enter into a full "party-line" communication. Thus, a dispatcher



Capacitators link communication system to high-tension lines

and several other stations may be in full communication with each other at one time, each being able to talk to all the others and each being able to hear the speaker.

Specifically, the General Electric Company type CC3D set used by the Southern California Edison Company is designed to give duplex conversation between similar sets, using the same frequency for transmission and reception. It is designed to be a multipower set; that is, the transmitter may be operated at three power levels, namely, 7½, 50 or 250 watts. The power supply is a 125-volt storage battery driving the necessary motor-generator sets.

The transmitter is composed of a master oscillator, control tube amplifier, control tube, speech amplifier, modulator and power amplifier tubes, together with the necessary circuit accessories. For duplex operation the master oscillator must operate with each audio signal above a certain intensity (room noise) and must cease to operate at the end of this sound. This is accomplished by means of the control tube in the following manner:

The control tube plate is connected to the filament of the master oscillator and the control filament returns to negative high voltage. There is, of course, positive high voltage on the master oscillator plate. The two tubes are, therefore, in series and a very high bias is normally on the control tube grid. Therefore, while "standing by" practically all of the voltage drop is across the control tube and the master oscillator cannot operate. When an audio signal of sufficient intensity reaches the microphone it is amplified by the control tube amplifier and impressed on the grid of the control tube. This lowers the resistance of the control tube, allowing more current to flow through the master oscillator, which causes it to operate. The audio-frequency signal (voice or "tone") is simultaneously amplified and impressed upon the output by the Heising system of modulation.

Features of Receiving Equipment

The receiver is practically a standard two-circuit receiver without regeneration or radio-frequency amplification. Sufficient signal is received from the transmitting station to permit using a detector tube only for the reception of speech, thus avoiding the amplification of noise. The protection of the receiver against the high voltages induced during transmission and the automatic gain control of the received signal are the only uncommon principles involved. Two tubes, known as the protective tube and gain control tube, have their plates in parallel and connected to one side of the secondary inductance of the receiver and their filaments to the other side of the same inductance. The grids are normally held slightly negative by separate bias batteries. The filament return circuit of the master oscillator flows through a 1,000-ohm resistance to negative high voltage. When the master oscillator draws plate current there is a voltage drop across this resistor. The grid of the protective tube is connected to the positive end of this resistor, which means that a positive bias is impressed on it, and the protective tube becomes a very low impedance which shunts and detunes the secondary tuned circuit, thus protecting the receiver from abnormal voltages. The operation of the gain control tube is quite similar to that of the protective tube, except that its grid potential is controlled by the drop across a 3,000-ohm resistor in the filament return of the detector tube to the negative of the plate supply. A separate six-volt filament battery is used on the detector tube to isolate it from the other tubes in the receiver.

For calling, one stage of amplification and what is known as the selector tube are used. The selector tube has a Wheatstone relay in the plate circuit, the plate current being biased to zero. When the 500-cycle dial-interrupted tone is received the plate current is increased, causing the Wheatstone relay to operate a selector relay, which, upon receiving the proper combination, rings a bell.

The type CC61 remote-control extension between Laguna Bell substation and the dispatcher's office in the Edison Building, Los Angeles, is a combination radio and audio channel. If audio, or, in other words, a standard telephone channel, were used, it would require two pairs of wires, since the inherent characteristics of the primary carrier necessitate the keeping separate of the transmitted and received signal. This, of course, could be accomplished by using a hybrid coil and balancing network on one pair. In fact, this method was employed prior to the delayed receipt of the CC61 extension.

The present extension transmitting unit located in the dispatcher's office is a low-power carrier-current transmitter, employing a 7½-watt oscillator and a modulator tube of like rating. The filaments are lighted by alternating current and the plate supply is obtained from a half-wave rectifier tube. To assure continuous service the 110 volts a.c. for filaments and plate supply rectifier is obtained from a 100-watt, 110-volt alternator direct connected to a d.c. motor operating from a 32-volt storage battery.

The extension receiver unit, located in the same building with the primary carrier at Laguna Bell, utilizes a detector tube and one stage of audio amplification. The detector tube has in its plate circuit a sensitive polarized relay. The plate current is biased down to about 1 milliampere. When the dispatcher starts the extension transmitter unit by lifting his receiver from the hook radio-frequency current is sent over the phone line, which causes the detector to pass more plate current, and the polarized relay operates. Associated relays are in turn energized by the polarized relay and the primary carrier equipment is started. Replacing the receiver on the hook shuts down the set by releasing the relays which function during operation.

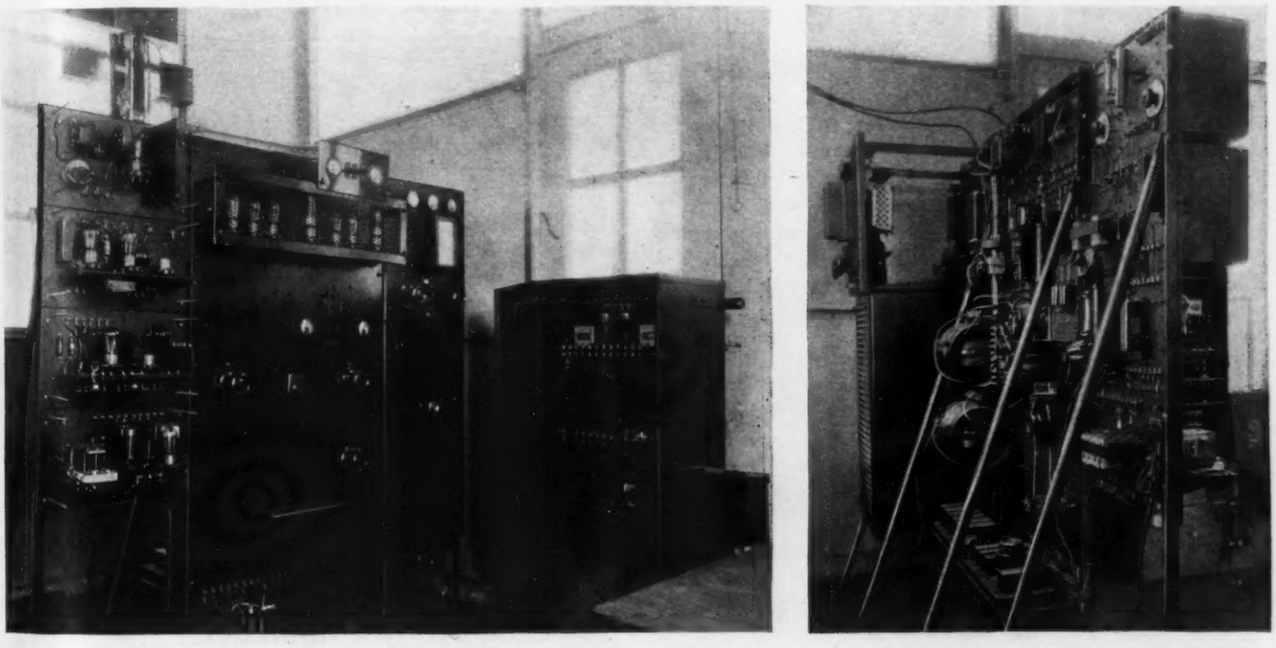
The carrier equipment at Big Creek was connected to the east line and the Laguna Bell equipment connected to the west line. The west line was energized and the east line was dead. Proceeding as shown in the following, satisfactory communication after each operation was established:

(a) Opened oil switches in the east line at three intermediate points, namely, Eagle Rock, Magunden and Vestal.

(b) Opened disconnects at the same three intermediate points.

(c) Shorted and grounded each line at each point.

Although under the above conditions it was found that 250 watts put through the best signal, it was possible to communicate satisfactorily on 7½ watts. Results of this test were quite pleasing. The manufacturer had offered no encouragement in the matter of getting through in a case of this kind unless by-pass condensers were installed. It is quite obvious that by virtue of the coupling between the adjacent lines the radio-frequency current was by-passed around the breaks. Should a break occur at the same point in both lines there is no doubt that communication would be interrupted on the carrier system.



Front and rear views of instrument panels for carrier-current telephone of Southern California Edison Company

Front view of board shows metal cover removed from four-section panel on left. Equipment in small cabinet on right is for remote-control extension to dispatcher.

Operation of the Equipment

Over a period of eight months a careful record was kept of all interesting details of the operation of the equipment. Operations averaged 50 per day. Transmission tests were made from time to time, under varying line conditions, covering the entire frequency band of the equipment, i.e., 150 kilocycles. Sixty kilocycles was selected as the optimum operating frequency for the Edison system. As yet by-pass condensers at the various switching points between Laguna Bell and Big Creek have not been provided. However, communication has been maintained under very adverse line conditions. One rather severe test was made, as follows:

Disturbances on the transmission system caused by flashovers, which frequently interrupt wire line telephone service, do not interfere with the operation of the carrier. On several occasions when flashovers have been of sufficient duration the dispatcher has been successful in communicating with Big Creek while the arc was taking place. We feel justified in stating that the carrier phone, because of the inherent strength of the transmission line and the immunity from power line disturbances, offers a very reliable channel of communication. In view of its dependability, the carrier phone adds a valuable supplement to the dispatching and operating communication system and the company expects to expand its carrier facilities from time to time.

Ice Prevented Along Spillway by Compressed Air

By F. A. Dale
Hydro-Electric Engineer Indiana Hydro-Electric Power Company, Indianapolis, Ind.

A COMPRESSED air system for preventing ice formation along spillway flashboards has been in successful operation for two winters on the Tippecanoe River in Indiana at the Norway plant of the Indiana Hydro-Electric Power Company. The flood discharge works at this plant consist of three stony gates and an overflow spillway 225 ft. long. This spillway is a solid masonry dam, the crest of which carries 2 ft. of flashboards supported on conventional steel pins or rods. Pond level is generally carried within 6 in. of the top of these boards, and if ice were allowed to form against the boards they would soon be carried away. In the past an open channel had been maintained along the boards by hand chopping, the men standing on the narrow ledge behind the boards. This work was hazardous and expensive and some improved scheme was sought.

A permanent addition to the top of the spillway was not feasible because of encroachment on discharge capacity and also because the masonry section was insufficient to withstand ice loading at the higher level. Collapsible flashboards set at an angle flat enough to turn

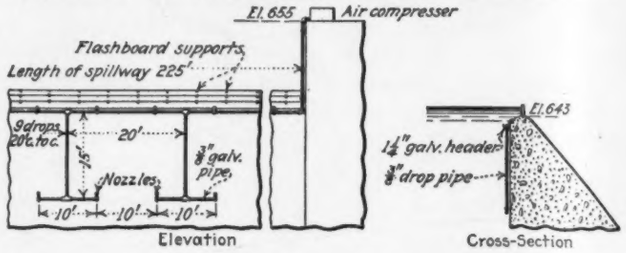
Ice-prevention system at Norway plant of Indiana Hydro-Electric Power Company

The average width of the open channel is about 8 ft. The picture was taken immediately after a period when the temperature reached 8 deg. below zero for four days. The ice on the pond was about 6 in. thick. In extreme temperatures of 20 deg. below zero the width of channel decreases to about 4 ft.

the expanding ice were considered, but the cost proved greater than a compressed air system. It was decided, therefore, to keep an open channel in front of the flashboards by means of air discharged under water. Normally no trouble arises from drifting floes of ice because the velocity in the pond is very low and the ice sheet generally melts away in place.

The location and arrangement of the air piping are shown in the attached elevation and section. The air outlets or nozzles, which are simply pipe caps with proper sized holes drilled in them, were originally spaced 20 ft. on centers, but this spacing allowed ice to form between outlets. The eleven outlets were graduated in size from $\frac{1}{16}$ in. nearest the supply to $\frac{5}{16}$ in. at the farthest outlet. With this graduation too much air was delivered to the far end. The number of outlets was then doubled (making 22) by adding a 10-ft. tee extension at the bottom of each drop, as shown, with an outlet at each end. This placed the outlets 10 ft. on centers. The openings were also decreased in size, with a range from $\frac{1}{32}$ in. to $\frac{5}{32}$ in., increasing away from the source. This arrangement proved satisfactory.

The pressure at the compressor is about 10 lb. per square inch, being equivalent to the hydrostatic pressure



Open channel maintained above spillway by escaping air

at the nozzles plus the velocity and friction losses. It was discovered that a slight slope on the cross tee supplying each nozzle pair would give one nozzle more air than the other. For this reason individual drops to each nozzle would be preferred. Air is supplied by a Worthington-Laidlaw vertical inclosed, self-oiling, feather-valve, air-cooled compressor with 4¼-in. bore and 4-in. stroke. The compressor is belted to a 5-hp., 1,800-r.p.m. motor driving the compressor at 500 r.p.m. and delivers 13 cu.ft. of free air per minute. The outfit is mounted on top of one of the floodgate piers, and although protected from rain and snow by an inclosure no attempt has been made to keep it warm. No difficulty has been experienced with the compressor or air lines due to low temperatures. The cost of compressor and motor amounted to $170, that for the entire installation being $443.

Special Alloy Eliminates Erosion of Impulse-Wheel Nozzles

EROSION of impulse waterwheel nozzles, always a problem in high-head plants, seems to have been successfully met by the San Joaquin Light & Power Corporation, Fresno, Calif., by the use of "Stellite," a very hard and tough alloy. At the company's recently completed Balch high-head plant bronze or cast-steel nozzles had a life of from 35 to 40 days only, due to the cutting action of the water.

Although the water is very clean and free from abrasive material it was found that the water passing through the 7½-in. nozzles with a velocity of 360 ft. per second under an effective head of 2,243 ft. had a very decided erosive action on the throat rings and nozzles of the 40,000-hp. double overhung waterwheel. By welding "Stellite" onto cast-steel nozzles no signs of erosion are evident on the main waterwheel nozzles after two months and on the exciter wheel nozzles after six months of operation. The alloy comes in ¼-in. rods and is welded onto the steel nozzles with an acetylene torch, after which the nozzles are put into a lathe and ground down with an emery wheel, since the metal is so hard and tough that it cannot be worked with a lathe tool. The work is done by the power company's men on the job at a cost of approximately $75 per nozzle.

Simplified

Distribution Planning

Methods of calculating the economic characteristics of electrical distribution systems, particularly transformer spacing and sizes of line conductor

By W. R. BULLARD

Electric Bond & Share Company, New York City

The system of planning described by the author was utilized in the rebuilding of an extensive and heavily loaded distribution system in a Southern city. The use of this method permitted the completion of the necessary preliminary calculations in record time, a few weeks sufficing, whereas if other means had been employed the job would have been greatly prolonged. The system has the particular advantage of permitting the inclusion of growth factors, thereby involving another improvement over other similar plans.

The primary distribution system of economical design is discussed in this first of four articles by Mr. Bullard. The secondary system will be incorporated in the next two installments. The fourth article will show the actual solution of a specific distribution problem by means of the equations previously developed.

As this device may be applied, through the choice of proper values, to any general problem of such character, the development should possess unusual interest.—EDITOR.

THE methods of establishing general features of economical distribution system design, with particular reference to conductor sizes and distribution transformer spacing, will be considered in this discussion. Once these features are established for any given system, their application to construction and operation becomes comparatively simple. Furthermore, these features, once properly determined, will usually be applicable for a period of several years without change, unless unforeseen circumstances should arise that would materially change local conditions.

Due to the variable nature of many factors that enter into the problem, it is not possible to reduce economical design to terms of absolutely correct figures. However, if the calculations are based upon reasonably sound general principles and are tempered with good judgment, the application of the results to a particular system cannot result in very great error in the over-all economics. This is particularly true since curves expressing the total annual cost of electrical distribution in terms of the various design factors are generally quite flat in the neighborhood of the point of minimum cost, and therefore small variations from exactly correct characteristics will not result in material changes in the total cost.

The methods described in this article will give approximate results only. However, for the reasons stated, it is believed that by their use sufficient accuracy for all usual purposes can be obtained. The methods given are applicable primarily to radial systems of usual types, but can be applied to automatic low-voltage alternating-current network distribution if the proper assumptions are made.

The writer gratefully acknowledges the assistance of W. T. Hess in offering many valuable suggestions during the preparation of this article, and of Malcolm W. Stumpf and Alfred Hudson in handling the detailed mathematics in the development of many of the equations.

PRELIMINARY CALCULATIONS

The first step in a study of the economics of the characteristics of any given distribution system is the calculation of two factors which will later be used repeatedly in calculations. These are: Copper loss duration factor and unit energy cost.

Copper Loss Duration Factor.—By copper loss duration factor is meant a factor that takes into account the shape of the daily and yearly load curves of any particular part of the system and enables the yearly copper loss to be derived from the copper loss at the yearly peak load by a simple calculation. A method of obtaining this factor is as follows:

First, a number of typical daily load curves for the particular territory in question are selected from a complete set of curves representing the whole year. These curves should represent the four seasons of the year and the different classes of days of the week for each season. For instance, curves representing a Sunday, a Saturday and a week day in each of the four seasons might be selected.

After selecting these curves, the next step is to pick values from each curve at equally spaced points of time throughout the day. The values should then be squared, and the squares, thus obtained, averaged for each curve under consideration, each resulting daily average being then multiplied by the number of the corresponding days in the season—that is, the mean square value for the Sunday curve in summer should be multiplied by the number of Sundays in the summer season, etc. The values should then all be totaled and this total divided by the number of days in the year. The resulting value when divided by the square of the peak load will be a fraction which, when multiplied by the copper loss at peak load, will give the average copper loss for the whole year. If the number of hours in the year is then multi-

plied by this fraction, the result will be a figure which, when multiplied by the kilowatt copper loss at peak load, will give the kilowatt-hour copper loss for the year.

As an example: The load factor in the business district of a large Southern city is approximately 36 per cent. The copper loss factor calculated by the method described is 18.2 per cent, or the figure to be used as a multiplier for the kilowatt loss at peak load to get yearly kilowatt-hours is 18.2 per cent of 8,760, or 1,600. The symbol f will be used to designate this latter factor in the equations given in this paper.

This process is rather laborious if a large number of representative curves are used. However, the method is subject to as great or as little refinement as may be desired, this refinement depending upon the number of typical curves that are selected and the number of points taken from each curve. The result is a very useful factor, since it can be used in the solution of many small problems that come up from day to day, as well as in the calculations described in this article.

The load curves of any given district, of course, do not represent exactly the load curves of individual small portions of the district. However, since we are concerned with average conditions and not with individual conditions, the factor derived by the method described will be sufficiently accurate for general application to various individual parts of the system in the district under question.

Since copper loss is a function of current rather than power consumption, the load curves should be reduced to values of kilovolt-amperes rather than kilowatts if convenient to do so. However, if the power factor is reasonably constant, it will be sufficient to use values of kilowatts throughout, since the desired value is a function of the shape of the load curves and not of the absolute values represented by these curves.

Unit Energy Costs.—The calculation of energy cost to any great degree of refinement is a laborious process. There are available in published form whole volumes of data concerning the methods and details of making such calculations. In this article, therefore, no attempt will be made to go into minute details of energy cost calculations. A very brief discussion will be given of a method of deriving approximate costs. If greater refinement of calculations is desired, other literature should be consulted.

In a general way it may be said that the costs of energy losses in a distribution system involve something more than bare production costs at the generating station. To obtain the actual production cost of energy losses measured at the point where they occur in the system it is, of course, necessary to increase the amount of these losses to their total value at the generating station, including the losses which they produce while passing through other portions of the system.

In addition to this, however, to obtain the total energy cost it is usually necessary to add a demand charge to the production charge, since in most cases the maximum losses in a general distribution system occur during the peak load of the system as a whole.

Demand Charge

The demand charge is in the nature of a charge on system investment in the portions of the system through which the losses have to pass before reaching the coal pile. To be exact, a demand charge should include certain items of operating expense at the generating station and substations. However, it is usually sufficient in calculating the cost of system losses to consider the demand cost as a definite percentage of the capital investment that is necessitated by reason of the additional system capacity necessary to supply the losses. When calculated in this manner, the demand charge should include allowance for interest on investment, maintenance, depreciation, taxes and insurance. To be theoretically exact, the demand charge in such portions of the system as substations, transmission lines, etc., should be calculated on the basis of kilovolt-ampere demand; and in such portions of the system as boilers and turbines should be calculated on the basis of kilowatt demand. However, if, as is usually the case, the power factor of the load in question is high during the peak load, it will be sufficient to use kilowatts as a basis for the entire calculations.

When the production charge and the demand charge have been calculated, these two charges should be combined to form the value for total cost per kilowatt-hour for copper losses and for transformer core losses. This can be done by using the copper loss duration factor in the case of copper losses and by using the total number of hours in the year in the case of transformer core losses.

As an example, assume that the average production cost at the generating station is $0.00665 per kilowatt-hour. The investment in various portions of the system per kilowatt peak load are as follows: Transmission system, $20; generating station, $140; substations, $60; distribution primary, $18. The energy losses at peak load are 5 per cent for substations, 5 per cent for transmission lines and 5 per cent for distribution primary. The yearly energy losses are 5 per cent for substations, 1 per cent for transmission lines and 1 per cent for distribution primary. The total production charges per kilowatt-hour on losses at the distribution transformers are therefore $0.00665 divided by 93 per cent, or $0.00715 per kilowatt-hour. The system investment necessary to serve 1 kilowatt of distribution losses is $18 plus ($60 ÷ 95 per cent) plus ($20 ÷ 90.3 per cent) plus ($140 ÷ 85.7 per cent), or $267.

Fixed Charges

If the fixed charges on investment, including interest, maintenance, depreciation, etc., are 15 per cent of the investment, the demand charge per year per kilowatt loss at peak load is 15 per cent of $267, or $40. Assuming that the load in question has a copper duration factor of 1,600 hours per year, the demand charge for copper losses reduced to cost per kilowatt-hour is $40 divided by 1,600, or 2.5 cents per kilowatt-hour; the cost per kilowatt-hour of copper loss at the distribution transformer is therefore 2.5 plus 0.715, or 3.215 cents per kilowatt-hour. Similarly, using 8,760 hours duration factor, the cost of transformer core losses is 1.17 cents per kilowatt-hour.

These values for investment charges are unusually high due to the geographical location of the system from which they were taken. In the example selected the location of the losses in the system was at the distribution transformers and fixed charges on the primary system were included. For other points in the distribution system the cost of losses would of course be different, depending upon the amount of distribution system through which they would have to pass. Therefore, if a high degree of accuracy is desired, a different cost value should be calculated for the losses in each portion of the distribution sys-

tem. However, reasonably accurate results can be secured by making the calculations for some mid point in the distribution system and applying the results to all the distribution losses.

In applying the cost of energy to calculations of system economics some engineers consider it permissible to neglect the charges for system investment. The argument is frequently used that the system is already installed and is available for serving load and that the losses form a very small part of the total load. The investment cost of serving losses is therefore assumed to be an imaginary rather than a real cost. Such assumption may be useful if it is desired to hold the distribution system investment down to the minimum consistent with reasonably good service, or, in other words, if it is desired to place a low valuation upon the cost of losses in the calculation of system economics, thereby permitting the installation of a cheap system with correspondingly high losses. Such procedure, however, should be used with great caution, since it may result eventually in increasing the investment in other portions of the system through which the losses have to pass to a greater extent than the investment is reduced in the portions of the system under consideration.

There can hardly be any more doubt that the investment cost of serving, say, 5 per cent of the system load in losses is a real cost than there is that the investment cost in generating station, transmission system, substations and distribution system to serve a 1-kw. customer connected to a large distribution system is a real and not an imaginary cost. The fact that the system may at present have sufficient capacity to take on additional load will not under usual conditions excuse the additional load represented by losses from bearing its share of the investment cost. With the steady growth of main system load additional system capacity must eventually be added and the present addition of any unnecessary load will necessitate the adding of that capacity proportionately sooner than would otherwise be the case.

Primary System

Spacing of Substations.—Much has been written about the economics of substation spacing and many formulas are available for the determination of such economics. Therefore no attempt will be made to treat this subject in detail in this article.

Primary Voltage.—The primary voltage of existing distribution systems is in many cases fixed by the previous history of the system's installation and growth. Due to the cost of making a change, the original primary voltage is often continued in effect year after year, or if a change is made this is done in such manner as to involve the least cost. However, with the rapidly increasing load densities that are usually encountered under modern conditions, many systems are now being changed to higher primary voltages and the economics of many other systems may demand that a complete change be made in such practices.

The primary voltages now in use for general types of distribution systems (referring particularly to three-phase systems) are 2,300 delta, 4,000 Y, 6,600 delta, 11,000 Y and 13,200 delta and Y.

The 2,300- and 4,000-volt systems are in the great majority and owe their popularity chiefly to the standardization during the past years of 2,300-volt distribution transformers and auxiliary apparatus. The 4,000-volt Y system is a natural outgrowth of the old 2,300-volt system, since by its use the load capacity of the primary conductors of an old 2,300-volt system can be increased 70 per cent merely by reconnecting distribution transformers in Y instead of delta and possibly reinsulating the primary system. For this reason the 4,000-volt system is used extensively in modern distribution practice and in fact during the past few years has almost become standard for three-phase radial overhead systems. However, in some cases economies are now being effected by the use of voltages higher than 4,000.

The chief advantage of the higher voltages over a 4,000-volt system lies in the fact that generating volt-

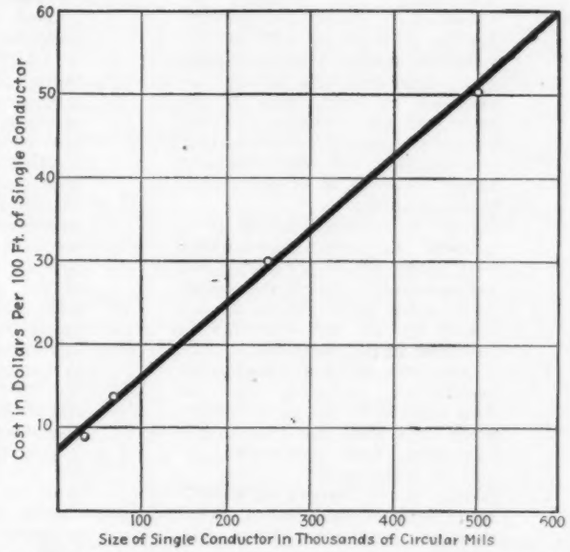


Fig. 1—Cable costs per conductor based on cost of four-conductor, low-voltage, lead-covered, paper-insulated, armored cable

ages can be employed and the use of step-down substation can be eliminated (assuming, of course, that the distance of the distribution system from the generating station is not so great as to require a transmission voltage higher than that of the generators). The use of the higher voltages may thus both improve the system efficiency and reduce the investment cost, unless perhaps the higher cost of line insulation and non-standard distribution apparatus should offset the saving made by the elimination of substations. This is seldom the case, however, since the latter saving is usually a very considerable one.

The chief disadvantage of the higher voltages are: First, that under many local conditions it is impracticable to work primary lines of voltages above 4,000 alive, thus necessitating some measure of interruption of service in radial systems when it is necessary to do work on the lines; second, that the natural consequence of the use of higher voltages is the concentration of large amounts of power in individual feeders of the primary system, thus causing interruptions of service to a comparatively large number of customers in radial systems in case of a primary short circuit or other trouble affecting the primary feeder; third, that governmental regulations in many cases prohibit the use of the higher voltages in overhead line construction in the city streets; fourth, that it is sometimes difficult to obtain the proper clearances necessary for the higher voltages in overhead construction, and, fifth, that the communication companies object to joint construction when certain of the

Symbols Used in the Development of Equations in This and Following Installments

a = Cross-section of each line conductor in thousands of circular mils.

b = Size of conductor in thousands of circular mils necessary to carry 100 amp. from heating standpoint.

C = Cost of copper loss expressed as a fraction of a dollar per kilowatt-hour. For accuracy the value of C should be different for the different parts of the distribution system. However, sufficient accuracy may usually be obtained by calculating C for some mid point between the substation and the customer's service and applying the value thus obtained to all parts of the distribution system.
NOTE: In systems where it is possible to keep transformers very nearly uniformly loaded and symmetrically spaced, the calculated value of C should be reduced by 25 per cent before insertion in the equations.

C_1 = Yearly cost of each transformer installation, including cost of losses and fixed charge on investment in dollars per installation per year. Cost independent of size of transformer.

C_2 = Annual fixed charges on investment in line conductors, exclusive of installation costs and including only that portion of the cost which is directly proportional to the size of conductors, in dollars per year per thousand circular mils per 100 ft. of single conductor.

C_3 = Annual fixed charges on average total investment costs of primary laterals in dollars per year per 100 ft. of complete circuit.
NOTE: For alternating-current, low-voltage network systems of the full automatic type, the calculated value of C_3 should be multiplied by the factor $(3 + x) \div 4$ before insertion in the equations. X equals the number of primary circuits feeding a single network.

C_4 = Cost of core loss expressed as a fraction of a dollar per kilowatt-hour.

C_5 = Annual fixed charges on cost of transformer installation, including cost of installing, purchase cost of transformer independent of size, cost of auxiliary equipment installed and cost of housing if any.

D = Load density at yearly peak load in amperes per 100 ft. per current-carrying conductor of secondary mains, exclusive of large concentrated loads.

f = Yearly duration factor for copper loss in equivalent hours per year for loss at peak load.

I_F = Current density at peak load in primary feeders in amperes per 1,000 circ.mil.

I_L = Current density at peak load in primary laterals (maximum current or current at end toward primary feeders) in amperes per 1,000 circ.mil.

L = Average length of each side of a block in 100-ft. units.

n = Number of current-carrying conductors in secondary mains, assuming balanced current.

n_1 = Total number of conductors in secondary mains, assuming neutral conductor to be same size as current-carrying conductors.

V = Maximum volts drop per conductor in secondary mains.
NOTE: In systems where it is possible to keep transformers very nearly uniformly loaded and symmetrically spaced, the value of calculated voltage drop obtained from the equations should be reduced 25 per cent, or the value of estimated allowable voltage drop V for insertion in the equations should be increased 33 per cent.

W = Power loss in kilowatts per 100 ft. per current-carrying conductor of secondary mains.

W_1 = Transformer copper loss in kilowatts per transformer installation, independent of transformer size.

W_2 = Transformer core loss in kilowatts per transformer installation independent of transformer size.

X = Number of primary circuits feeding a single network in a full-automatic, low-voltage alternating current network system.

higher voltages are used. Both of the first two objections to the use of higher primary voltages can be somewhat offset by the use of a higher factor of safety in line construction and by the installation of sectionalizing devices of both manually operated and automatic types, so as to break up the primary circuits into smaller units, both for purposes of working upon lines and for short-circuit protection. Both the increased cost of the higher grade of construction and the use of additional apparatus, of course, tend to offset the saving effected by elimination of substations.

Assuming that the last three of the five objections mentioned can be overcome, it may be said in general that the selection of high primary voltages in order to obtain the economies afforded by the elimination of substations involves mainly the question of the importance of reliability of service. If a somewhat less degree of reliability of service can be tolerated, then usually it is advantageous to select the higher primary voltages, the result in most cases being a saving in investment and improvement in system efficiency. This statement, of course, applies to radial systems and not to multiple-feed, low-voltage networks. In the latter type of systems reliability of service is assured by the automatic features of the system and the chief objections to the higher primary voltages are thereby eliminated, particularly since low-voltage network systems usually involve underground construction and therefore the last three objections mentioned do not apply.

Determination of Loads of Individual Feeders.—The determination of the loads of individual feeders for a radial distribution system is something more than a question of economics. Theoretically the most economical size of feeder would involve concentrating as much load on a single feeder as geographical considerations and distances of feed would permit. However, the question of reliability of service is an important factor in the problem and the requirement for greater service reliability is that the primary system be split up into units of very small size. The actual selection of the loads of primary feeders must therefore usually be based upon a compromise between economy and reliability of service. This becomes largely a matter of judgment concerning the importance of the reliability of service in any given system. If small primary feeders are used, relatively small portions of the system will be affected by a single primary short circuit, but the investment cost in the system will be comparatively great. If large units are used, the cost will be reduced, but larger areas will be affected in case of primary short circuit.

There are, however, certain other factors that enter into the problem—namely, available standards of feeder terminal equipment and local geographical conditions.

By feeder terminal equipment is meant such apparatus as induction regulators, feeder circuit breakers, etc. Such equipment has been fairly well standardized, and in general it will be found that a reasonable compromise between service reliability and economy can be made by

the selection of feeder loads to fit existing equipment standards. Such selection will, of course, result in a lower relative cost of the terminal equipment than if non-standard sizes are used.

Geographical conditions may also sometimes play an important part in the determination of feeder loads, That is, in some cases the configuration of the system and the geographical distribution of the system load may be such that primary circuits will fall naturally into certain uniform units of load.

The above discussion of course applies to radial systems of distribution. In the case of multiple-feed, low-voltage networks the conditions are somewhat different. Here the reliability of service is reasonably independent of the number or size of primary feeders and it is possible in many cases to work out mathematically the proper size of feeder from considerations of economics. The mathematical solution of this problem is quite complicated and will not be included in this article.

Voltage Drop and Current Capacity vs. Economical Current Density.—The above discussion relates to the determination of the loads for which primary feeders and circuits are to be designed. So far nothing has been said concerning the size of copper which should be used in the primary feeders to handle a given amount of current. In the solution of this problem three factors must be considered—namely, economical current density, voltage drop and current-carrying capacity.

The investment cost of primary lines is made up of two parts, one being a value that is practically independent of the size of copper and which, therefore, does not enter into the problem. In overhead lines this includes poles, hardware, insulators, etc., and in underground lines conduit, manholes, cable insulation, lead sheath, etc. The costs of such things as cable sheath, cable insulation, etc., in underground lines are not entirely independent of the copper size. However, by plotting cost per unit length of line against copper size a curve can be obtained which is usually very nearly a straight line. In Fig. 1 the point where this curve cuts the cost axis represents a cost that is entirely independent of the copper size, and this cost, therefore, does not enter into the calculations of economics. The slope of the curve, however, is a measure of the variation of cost with copper size and is very useful in determining the economical current density.

If I_F represents the current density at peak load in amperes per 1,000 circ.mil of conductor cross-section; C_2 represents the fixed charge in dollars per year on the cost of copper per 100 ft. of conductor per 1,000 circ.mil; C equals the cost of copper loss in dollars per kilowatt-hour, and f equals the duration factor previously described, then the total variable yearly cost per ampere of load per 1,000 circ.mil cross-section per 100 ft. of conductor, including fixed charges on investment and cost of copper loss, is given by the expression $C_2 \div I_F + 0.0011CfI_F$, where 0.0011 is a factor determined by the resistance per 100 ft. for 1,000 circ.mil cross-section, a reasonably high temperature of copper being assumed.

In order to obtain the value of I_F for minimum cost, it is merely necessary to use the familiar method of differentiating the expression of total variable cost and equating the result to zero. This gives

$$I_F = \sqrt{\frac{C_2}{0.0011Cf}} \qquad (1)$$

This formula can be used for calculating the economical current density in a primary feeder. It may be, however, that for given system conditions the use of the economical size of copper would give a greater voltage drop than can be permitted. Therefore, after calculating the economical current density, the resulting values should be tested for voltage drop in the individual feeders. If the result of this test is a greater voltage drop than permissible, then the proper current density must be determined by calculation from allowable voltage drop, unless the current-carrying capacity of the copper as limited by temperature should still further limit the current density.

In overhead systems current-carrying capacity is hardly ever the limiting factor in determining current density. However, in underground systems the reverse is sometimes true. Therefore, after the above calculations for economics and voltage drop are made, the resulting current density should be examined to determine whether it would overload the copper. If so, then the current density to be used must be recalculated with the heating of the copper as the limiting factor.

By use of this method the calculation of the proper size of copper for primary feeders is a comparatively simple process. However, in the case of primary laterals, there are other factors that must be considered. In a radial system it is usually convenient to use two or three different sizes of copper in the primary laterals beginning with the largest size directly at the feeder terminal and tapering off toward the smallest size at the greater distances from the feeder. It must be borne in mind, however, that the primary system is continually changing to meet load demands. Therefore too great use of the smaller sizes of laterals should not be permitted. The larger sizes should be extended to form at least a skeleton of trunk lines interconnecting with the trunk lines of other feeders so that the copper of the primary laterals will be sufficient to permit shifting of load from one feeder to another by cutting and splicing or to permit picking up the load of an adjacent feeder in case of emergency.

In a system in which the primary laterals are thus laid out to take care of load growth and to permit emergency operation, the size of copper in a large portion of the laterals usually bears little relation to the load carried under normal conditions, and the losses are usually so small that the economics of copper loss vs. cost of copper do not enter into the problem. The laying out of the primary laterals thus becomes a matter of judgment and careful planning for future system conditions. However, cases may be encountered where it is desired to determine the economics of current density in primary laterals. In such cases a modification of equation 1 can be used as follows:

In a primary feeder the current is the same throughout the entire length. In a primary lateral the current varies from point to point due to the distribution of load along its length. For convenience a uniform distribution of load can be assumed. With such load distribution the power loss in the copper is one-third what it would be if the current at the end toward the feeder were present throughout the entire length. Thus, if I_L equals the maximum current of the primary laterals, or, in other words, the current at the end toward the feeder, we get by introducing the factor $\frac{1}{3}$ in the derivation of equation 1

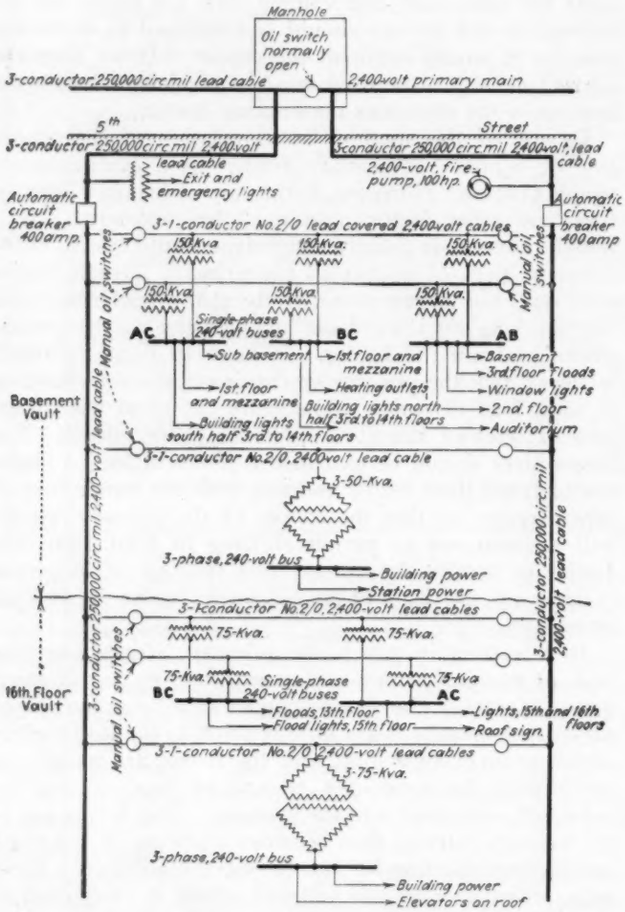
$$I_L = \sqrt{\frac{3C_2}{0.0011Cf}} \qquad (2)$$

Transformers on Upper and Lower Floors Save Copper

By T. W. Swartz
Assistant Engineer Underground Department, Northwestern Electric Company, Portland, Ore.

STUDY of the distribution problem in the new sixteen-story office building housing the three American Power & Light organizations centered in Portland, Ore., showed that two transformer vaults centrally located with respect to the 750 kva. demand to be served would result in reducing secondary copper expense and add to the reliability of service.

The accompanying schematic diagram shows how the



In serving a large office building 2,400-volt feed was carried to a roof transformer vault to reduce total wiring cost

problem was worked out. Two transformer vaults were provided, one in the basement and the other on the sixteenth floor. The latter contains 300 kva. in lighting transformer capacity and a 225-kva. bank for three-phase power service and is fed by two three-phase, 2,400-volt lead-covered cables carried 240 ft. vertically in the building.

All lighting and power on the fifteenth and sixteenth floors and a 100-kw. floodlighting load on the thirteenth and fifteenth floors are fed from the sixteenth floor vault. A large saving was made on the elevator feed, which consists of six 750,000-circ.mil rubber-covered cables supplying four 35-kw. motor-generator elevator sets, with provision for a fifth. The wire run was reduced from 250 ft. to 14 ft.

In the basement vault there is 900 kva. in lighting transformer capacity and 150 kva. for three-phase power. The service feed from this vault is indicated by the secondary feeder designations in the diagram. Duplicate 2,400-volt feeders from a ring feeder system serve the building as a whole. A sectionalizing switch was placed between the two building feeders in the street manhole to permit the load to be separated normally.

Two 250,000-circ.mil lead-covered cables were carried up the elevator shaft in conduit to the roof vault, without change in size to avoid fusing at points of reduced size, in compliance with the city code. At the end of each 10 ft. section of conduit was placed a pull box, in which the cable is supported by a woven copper wire strap.

In both vaults the lighting load is supplied by what amounts to a duplicate feed. The lighting transformers are banked in pairs and loaded to 150 per cent of the rating of one transformer. Normally each transformer in a bank carries 75 per cent of rated load, but in case of emergency one transformer can operate at 150 per cent of rated capacity to carry the entire load. All transformer secondary leads are carried to copper buses in the vaults to facilitate connection changes in emergencies.

Further details as to switching arrangement, buses, etc., are shown by the schematic diagram.

Costs of Central Station Service Buildings

FROM the cost-estimate sheets of an Eastern power company are taken the data in the accompanying table relative to various building construction work required in connection with miscellaneous maintenance activities. The costs represent 1927 figures.

SERVICE BUILDING COSTS, 1927
(Excluding All Overhead)

Group consisting of	
Heavy storage building, one story, 101 ft. 4 in. x 222 ft. 10 in. x 29 ft. 10 in. high; concrete foundations, steel frame, brick walls, concrete floor, two indoor railroad track pits, two indoor motor truck pits, four rolling steel doors, two 10-ton Shaw electric cranes:	
Connecting building, one story, 18 ft. 8 in. x 222 ft. 10 in. x 17 ft. 4 in. high, general construction similar to above, one Sheppard hand travel electric lift crane: and	
Light storage building, three stories, same ground dimensions as heavy storage building, 42 ft. high, first floor concrete and other floors mill construction, shipping platform and two Otis freight elevators, all above with heating, lighting and plumbing	$385,793
Office building, three stories, 41 ft. 6 in. x 153 ft. 6 in. x 39 ft. 4 in. high, and 10-ft. basement, concrete foundations and basement floor, mill type construction, concrete walls, two dumb waiters and one automatic passenger elevator, with heating, lighting and plumbing	190,454
Garage, one and two-story building: first story 115 ft. x 263 ft. x 18 ft. 4 in. high; second story 115 ft. x 62 ft. x16 ft. 6 in. high; reinforced concrete construction, brick walls, with lighting, heating and plumbing equipment	218,383
Oil house, one story, 27 ft. 10 in. x 93 ft. 2 in. x 17 ft. high, with 10-ft. basement and wing 17 ft. 1 in. x 22 ft. 2 in. x 14 ft. high, reinforced concrete construction, wood block platform, one Sheppard 1-ton electric crane, lighting, heating and plumbing	18,841
Gate house, one story, 10 ft. x 17 ft. x 10 ft. 6 in. high, concrete foundations and floor, brick walls, tar and gravel roof, with lighting and heating equipment	2,113
Tank and tower, capacity 100,000 gal., foundations plain concrete, 11 ft. square on base and 3 ft. 8 in. square on top, 8 ft. high, reinforced concrete pit, steel tank and tower 123 ft. 2 in. (top of tank above ground)	10,919
Storage sheds, nine, 15 ft. x 31 ft. x 8 ft. 6 in. high; foundations 6-in. x 14-in. hard pine mud sills, wood superstructure and floor	3,136
Blacksmith shop, 8 ft. x 10 ft. x 7 ft., foundations 6-in. x 6-in. hard pine and sills, wooden superstructure and floor	157

Service Restoration Expedited

A detailed description of how service or trouble dispatching is organized and handled by the Metropolitan Edison Company

By J. E. SHALTER
Chief Service Dispatcher Metropolitan Edison Company, Reading, Pa.

Service dispatching office — Under glass cover of center cabinet are maps showing locations of transformers, feeders, arc and incandescent-lamp circuits. Below are feeder boxes, gasoline lamps and storage-battery portable spotlights used for distribution trouble. Pneumatic tube communication is afforded with the system operator's office.

THE service dispatching department of the Metropolitan Edison Company at Reading, Pa., takes care of all troubles on the distribution system supplying 34,096 customers within a radius of 20 miles, making about 500 calls per month of an average length of 1 hour and 13 minutes. The personnel consists of one chief and four assistant service dispatchers, three linemen and three assistants, two inside service men and one street-lighting inspector. The department provides 24-hour service, with at least one dispatcher, one lineman and one assistant lineman on duty. The shifts of the linemen and assistant linemen are arranged so as to have two of each on duty between 7 and 8 a.m. and 2 and 4 p.m., in order to take care of the most important times of the day. If the dispatcher needs additional help in emergencies during the day, he may draw from any of the line gangs, of whose whereabouts he is kept constantly informed, whereas at night he calls as many men as he may require.

A lap in the shifts of the inside service men is also arranged so as to have two men on duty between 11 a.m. and 5 p.m., with "one-man service" during the remainder of the time from 7 a.m. to 9 p.m. At times when these men are not out on trouble they are employed repairing and calibrating meters in the meter department, which forms a source from which four or five extra men can be drawn in emergencies.

These men take care of service complaints involving meter trouble or blown service fuses which are maintained by the company. Cases of such trouble occurring at night are handled by one of the service linemen. Inside trouble is the only case where only one man is sent; all other troubles must be handled by at least two men. The street lamp inspector is on duty at night and is required to keep all street lights in the city and suburbs working properly. He works in conjunction with the city police department, which receives most reports of outages, and reports hourly to the service dispatcher.

During severe storms all of these men, as well as a large number of line department employees, either report for duty or call in to inquire if their services will be needed.

Four maps, which are kept constantly up to date, are used in the office for the city; similar maps are used for suburban sections, one map shows distribution lines and locations of all transformer banks, with their num-

bers, different colors being used to indicate if the lines are three phase or single phase, 2,300-volt, 13,200-volt or underground cables Lines and locations of city incandescent street lights appear on another map, with similar maps for arc lamps and for street railway distribution, the latter showing locations of feeder taps, breakers, crossings, etc.

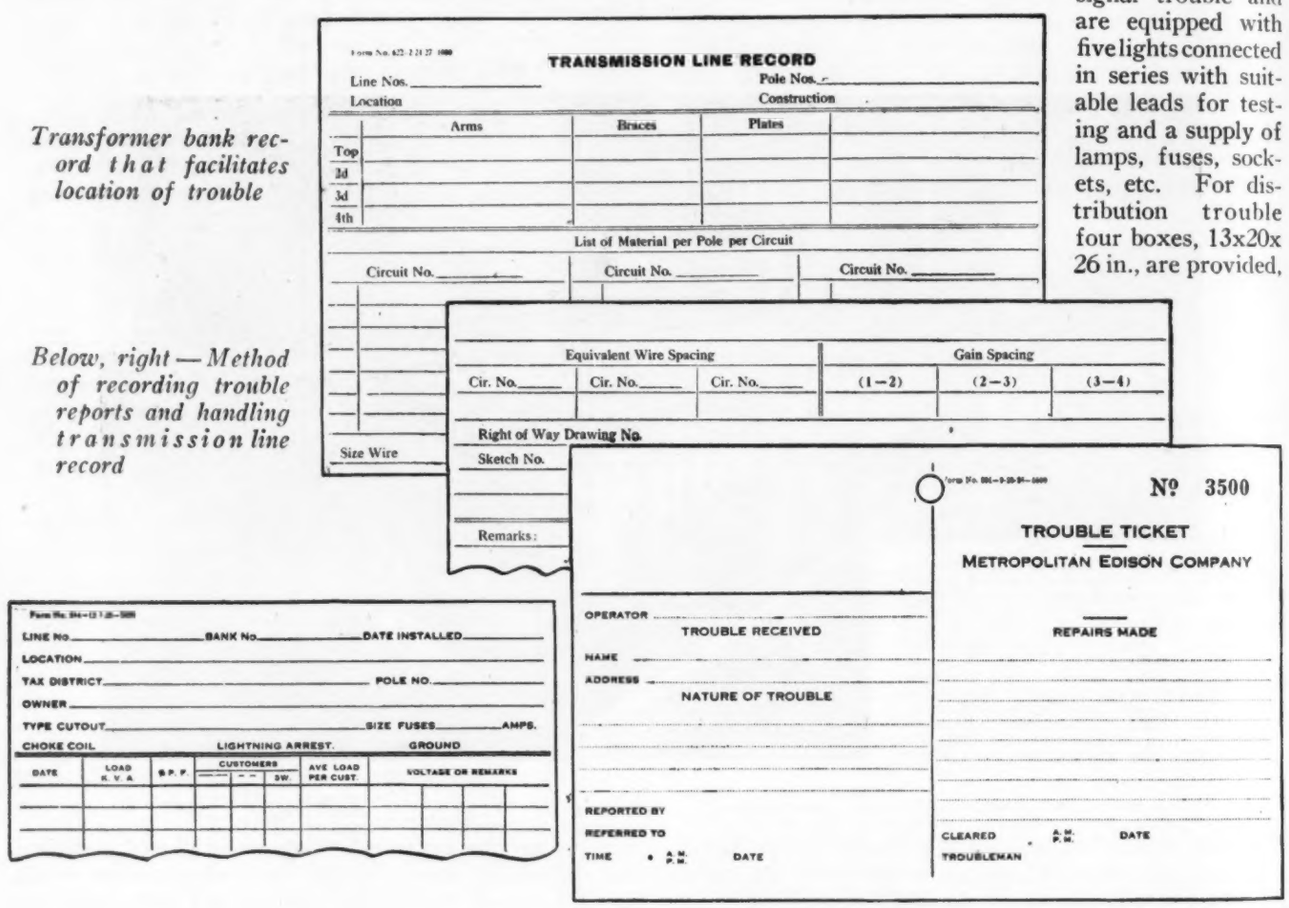
The distribution file uses 4x6-in. plain salmon-colored cards for the location, type and size of line fuses, and yellow cards for transformer banks, giving data on transformer fuses, lightning arresters, etc.; space is also provided for recording the results of load checks. A blue card is used for each unit of a transformer bank to give complete data on the unit, including test results of losses, impedance, regulation and efficiency and a chronological record of locations at which it has previously been in service. All customers, with their addresses, are listed on white cards. These cards are arranged in the file in the order given above according to line numbers, bank numbers and customers on each bank. Transformer banks are numbered consecutively on each line, with the line number preceding; for instance, No. 108-3 means Bank No. 3 on Line No. 108.

Complete up-to-date information is kept on a "transmission line record" of material used on poles, size of the line wire, type construction, etc. Pole records are filed according to number, also according to location, a yellow card being used for Metropolitan Edison Company and a blue one for Reading Transit Company poles. Poles are numbered consecutively, with a distinguishing letter to designate the district if suburban distribution lines and with the line number if a transmission line pole.

Service men are provided with two Chevrolet trucks equipped with hand searchlights, switch sticks, a supply of all makes and sizes of fuses, a quantity of wire and a full set of tools required for any emergency job. One Ford truck is equipped with four portable high-powered searchlights. The inside service man uses a Chevrolet touring car which carries a complete supply of 110- and 220-volt fuses and sealing equipment, as about 40 per cent of the service switches are sealed. For emergency service, when all of the above-named equipment is in use, the service men use standard touring cars and a handbox, of which thirteen are available. Nine of these boxes, about 7x7x20 in., are used for street railway signal trouble and are equipped with five lights connected in series with suitable leads for testing and a supply of lamps, fuses, sockets, etc. For distribution trouble four boxes, 13x20x26 in., are provided, containing a supply of all types and sizes of line, transformer and secondary fuses. In the office a complete supply is also kept of all fuses and fuse holders so as to make it unnecessary to waste time going to the storeroom for such material. Nineteen additional storage battery type searchlights and sixteen two-burner gasoline lamps are always available for immediate service.

Transformer bank record that facilitates location of trouble

Below, right — Method of recording trouble reports and handling transmission line record



Procedure Followed

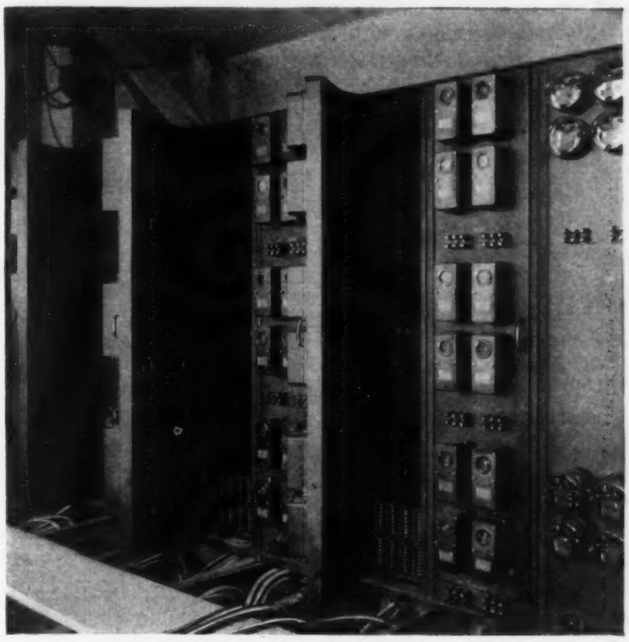
When the service dispatcher receives a large enough number of "no light" or "no power" calls to indicate that a transformer or line fuse is probably blown, he makes out a trouble ticket in duplicate, giving the name and address of the party and the nature of the trouble reported, and stamps both in the calculagraph. Referring to the distribution map, he obtains the transformer bank number. With this he can ascertain from the distribution file the exact transformer location and type and size of fuse, type, size and voltage of the trans-

former, and from the list of customers following he has a check on having located the proper bank. All this information, and in addition the type, size and location of line fuse, is noted on the trouble ticket and the original is then given to a service man. Upon his return to the office he notes on the trouble ticket what repairs he has made and whether they are temporary or permanent. The dispatcher again stamps both the original and the duplicate in the calculagraph, thus having a record of the exact time consumed. The original is filed in the office and the duplicate is sent to the engineering department to keep that department's records up to date as regards any changes that may have been made by the service man. In case a temporary repair was made, due to its being too large a job for the service man, the dispatcher makes out a "work order" giving all details of what remains to be done and turns it over to the general line foreman. The duplicate is held in the file as a check on uncompleted work and is given to the foreman as soon as he turns in the original properly made out.

When a report of "no light or power" is received from a customer fed from 13,200 volts, a "trouble ticket" is made as before. This is sent to the local dispatcher through a pneumatic tube connecting the two departments. The local dispatcher, if the line is energized, fills in the transformer and fuse data and returns the ticket to the service dispatcher, who checks this information and dispatches a service man, the procedure thereafter being as outlined previously. When the local dispatcher or system operator has trouble with any of the transmission lines, he makes out the "trouble ticket" and sends it to the service dispatcher, who immediately sends out four or more patrolmen in case the location of the trouble is not known. These men are told to stay clear of the lines at all times and immediately to report from the nearest telephone anything they find. The man locating the trouble is ordered to stay at that point until the repair crew arrives. The service dispatcher refers to the transmission line record file, which gives, as previously stated, complete information on material used on the various poles, and dispatches a repair crew with a sufficient amount of the proper material to make any necessary repairs.

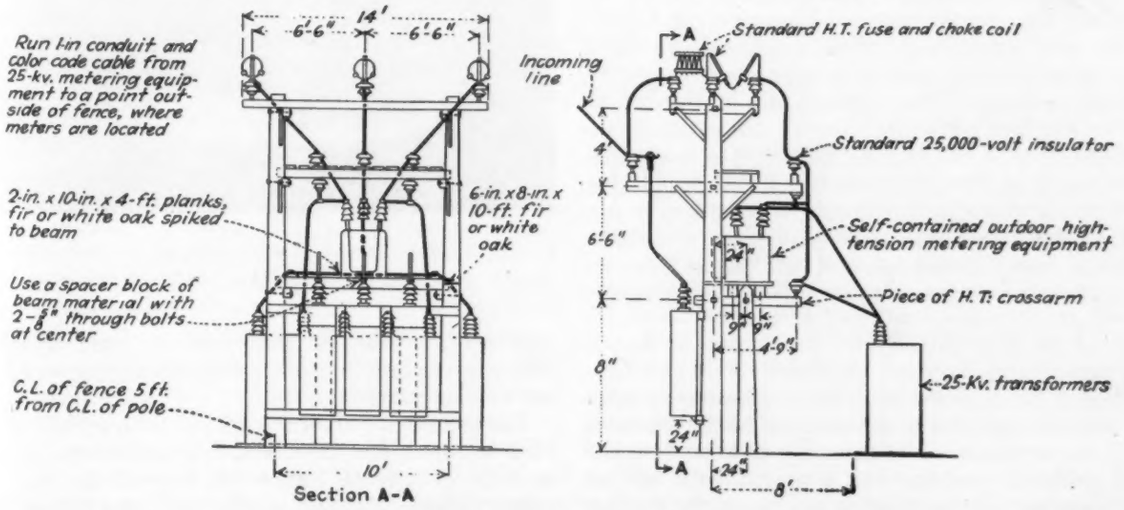
On individual "no light" calls the ticket is merely made out with the name and address and referred to the inside service man during the day and evening or to any available service lineman at night, but the disposition of the completed tickets is the same as in all cases given above.

Hinged Panels Reduce Space Requirements



RELAY boards in the control room of the ventilating buildings of the Holland vehicular tunnel are provided with hinged panels. This construction permits full accessibility of wiring and minimizes space demands behind the boards. Fishbach & Moore, Inc., was the contractor. Service is supplied by the United Electric Light & Power Company and the Public Service Electric & Gas Company of New Jersey.

Self-Contained 25-Kv. Metering Equipment


Run 1-in conduit and color code cable from 25-kv. metering equipment to a point outside of fence, where meters are located
2-in. x 10-in. x 4-ft. planks, fir or white oak spiked to beam
Use a spacer block of beam material with 2-⅞" through bolts at center
C.L. of fence 5 ft. from C.L. of pole
14'
6'-6"
6'-6"
6-in. x 8-in. x 10-ft. fir or white oak
10'
Section A-A
Incoming line
A
Standard H.T. fuse and choke coil
Standard 25,000-volt insulator
Self-contained outdoor high-tension metering equipment
Piece of H.T. crossarm
25-Kv. transformers
4'
6'-6"
8"
24"
9"
9"
4'-9"
8'

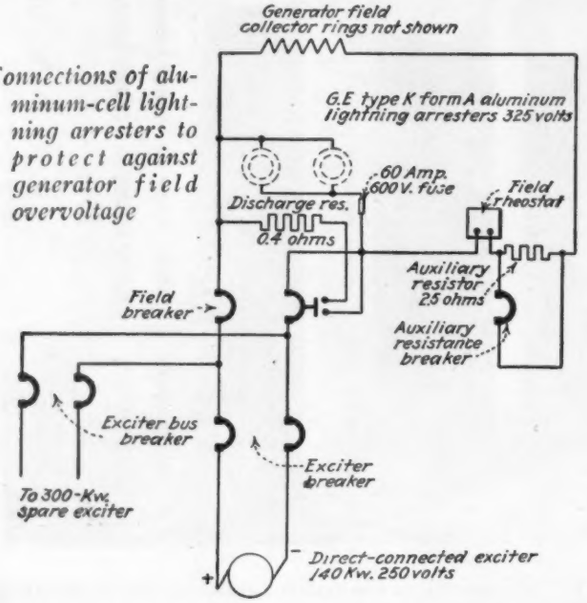
Standards of West Penn System

Protecting Generator Fields Against Overvoltage

By R. B. Greenwood
Moccasin Plant, Moccasin, Calif.

THERE are a number of cases on record of severe trouble developing as the result of the field circuit of a large alternator becoming open-circuited. The usual cause of such an open circuit is the failure of a splice between field coils or the opening of a circuit breaker that is not provided with a discharge resistor contact. Suddenly introducing a large block of resistance into the field circuit by the opening of a circuit breaker will also result in overvoltage.

Connections of aluminum-cell lightning arresters to protect against generator field overvoltage



The increase in voltage referred to is due to self-induction. When the number of turns, amperes and area of the magnetic circuit is considered it is obvious that destructive voltages may possibly result from the decaying flux when the field current of a large machine is suddenly and completely opened. Field circuit breakers invariably are provided with extra contacts which connect a resistance of low value across the field leads somewhat in advance of the complete opening of the circuit. The energy that would appear as an arc at the breaker contacts is thus dissipated as heat. Troubles have resulted from discharge clips failing to make proper contact. These parts should be checked as part of the machine's routine monthly inspection.

Protection against excitation circuit overvoltages has been obtained in a few hydro-electric plants by the installation of aluminum cell lightning arresters. An installation of this nature was made in the Moccasin plant of the city of San Francisco a year ago and to date has proved very satisfactory. In this plant car-type aluminum cell arresters are connected across the circuit of each field of the four 20,000-kva. generators, as shown in the accompanying diagram. A 60-amp., 600-volt fuse is connected in series with each pair of arresters to protect the circuit against the possible, although remote, failure of the arresters. The two cells and the fuse are contained within a wooden box provided with hinged door and mounted on the concrete wall near the rear of each exciter breaker panel.

It will be noted from the diagram that the exciters at the Moccasin plant are direct connected. Since there is an exciter breaker and an auxiliary resistance breaker in each field circuit the opening of either breaker will result in overvoltage, and it is largely for this reason that arresters were installed. The auxiliary resistance breaker is opened by voltage relays, and relay action has occurred a few times, also exciter breakers have been opened by accident. The arresters have functioned properly during these abnormal conditions. The exciter voltage varies between the limits of 90 to 205 volts throughout the day, depending on load conditions.

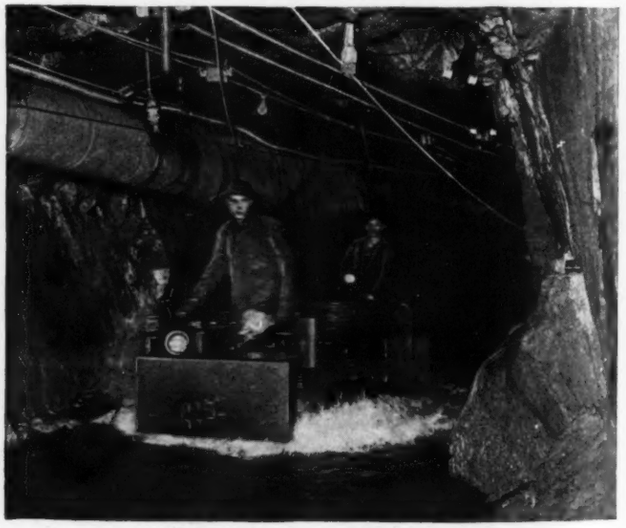
Being continuously connected to circuits that are energized the greater part of each day these arresters do not require charging. As regards maintenance, the electrolyte is changed annually and the plates will be replaced as found necessary, which will probably be every three or four years.

The complete cost of each arrester installation per generator was approximately $50, which is a small sum to invest for the protection secured.

Electric Locomotives Operated in 1 Ft. of Water

SO GREAT has been the water encountered by the contractor in driving the 7.8-mile Great Northern railway tunnel under Stevens Pass in the Cascade Mountains of Washington that it is often necessary to operate electric locomotives with 15,000 gal. of water per minute flowing through the tunnels, submerging the tracks under 6 in. to 1 ft. of water.

That the 44 six-ton locomotives used in this work are able to operate at all under such conditions seems incredible; nevertheless, comparatively little trouble has been experienced, only six armatures having been burned out in two years.



Water is no drawback to operation of electric locomotives in tunnel work

The locomotive shown is of the trolley and reel type. Five hundred feet of cable on a motor-driven reel is used to operate the locomotive beyond the end of the trolley where blasting would tear down the trolley. Several storage-battery locomotives are used as well.

Opposes Contract to Regulate

Companies declare constitutional rights threatened by abolition of court appeal. Economic weakness of proposal put forth by counsel for companies

CHAIRMAN ATTWILL'S recent arguments, on behalf of the Massachusetts commission, before the legislative committee on power and light in regard to House bill 170, providing for regulation by contract, were summarized in the ELECTRICAL WORLD, March 3, page 479. Fifty-four gas and electric companies represented by Sheldon E. Wardwell, counsel for the Massachusetts Gas and Electric Association, opposed the measure, contending that it would nullify the right of court appeal, confiscate a considerable portion of accumulated assets, dry up the wells of fresh capital and stagnate development. Extracts from Mr. Wardwell's argument against the bill follow:

"During 1927 90 rate reductions by Massachusetts gas and electric companies were announced, and this year numerous others have been filed. Most of these reductions were made voluntarily. As was the case a year ago, I am not here today to attempt to justify all rates. The last few years have been a period of unparalleled business activity and electric companies have been prosperous. Possibly other electric rates should be reduced.

"In justice to the electric companies, however, it is believed that this committee will recognize that every element entering into the cost of electric service has increased in price since pre-war days. Yet in the face of this increase, out of all prices which enter into the cost of living, electric rates alone have been reduced. The electric companies have on the whole paid no excessive return to the stockholders. Most companies have neither earned nor paid an exorbitant return, nor have they charged exorbitant rates. The main reason that the impression of a large return exists is that the return is quoted in terms of an unfair level or base.

ASPECTS OF WORCESTER CASE

"During the last year there has been a certain amount of agitation and criticism of the rates of electric companies. The department has ordered some rate reductions. Most of those ordered have been put into effect by the companies. In one case, that of the Worcester Electric Light Company, the commission ordered a cut in the lighting rate from 7 to 5 cents. The Worcester company, which was then giving the lowest lighting rate of any company in the state, sought relief from the order of the commission by proceedings in the federal court and obtained an injunction. The trial of its case is assigned to begin before a master on April 15. Three principal points appear to be involved:

"1. That in making their order of reduction the commission took as its justification the wrong rate base and refused to allow a return on the fair value of the company's property.

"2. That in estimating that a 6 per cent return is adequate, as the commission stated in that case and again in the Cambridge case recently decided, the commission assumed too low a rate of return.

"3. That in fixing a rate as low as 5 cents per kilowatt-hour the commission would force the company to serve a very large percentage of its customers at a loss.

"The commission made a flat reduction from 7 to 5 cents in the Worcester rate. The utilities believe that this flat rate method of rate making by the commission is unfortunate; that it produces inequitable results as between different classes of consumers and that establishment of a flat maximum rate at 5 cents compels the company to serve a very large percentage of its consumers at a loss and compels it to hold up rates to other consumers not only now but for the future, and that this is a very bad thing for the industry and for the community. The majority of the Worcester consumers using 15 kw.-hr. or less per month will be paying a total bill of 75 cents or less. It is less than the cost of service and produces no return to the company. It is inequitable to expect the larger consumers to make up the loss, and if the business of a community suffers a period of stagnation the power and commercial lighting customers will show a decrease in demand and the company will be unable to make up its loss.

"It is well recognized throughout the industry and by the regulating commissions elsewhere that the method of rate reduction adopted in the Worcester and other cases produces inequitable results between the consumers and that it is an antiquated and illogical method of rate making. I admit that it has been the custom of the commission for many years to adjust on a flat rate basis, but this was because the commission claimed that it was governed by a provision in our laws which allowed it to deal only with the maximum rate. Last year the commission received power to deal with all rates. I at least had hoped that in future the commission would adopt a practice which exists elsewhere and that instead of dealing with the maximum rate only, and forcing a company to sell a large part of its product at a loss, the commission would adopt the practice of determining a rate reduction by ordering a company to reduce its revenue a certain number of dollars, leaving the company to put in rates which were equitable to the different classes of consumers. I say without hesitation that if the commission adopted this practice there would be a greater probability that its rate reduction orders would be considered acceptable by the utilities, which in this respect believe that they are foresighted and looking for the good of the community as well as for the good of the industry.

SIX PER CENT TOO LOW

"The second difference between the utilities and the commission is that the board says a 6 per cent return is adequate. 'Very attractive,' it says in the recent Cambridge decision.

"The utilities believe that a 6 per cent return is inadequate, that it will fail to attract the investors' money to the industry. For many years hardly any commission

decisions have suggested that a public utility was entitled to less than 7 per cent, and a great many of them have allowed 8 per cent or even higher. If Massachusetts decides that 6 per cent is all a utility is entitled to earn, Massachusetts will cease to attract capital, and capital is essential for growth, and growth is essential if we wish to continue rate reductions, as it is only through mass production that this can be made possible.

The Appeal to the Courts

"Now we come to the more spectacular, though perhaps not more important, part of the controversy between the commission and the utility which produces this attempt by the commission to forestall an adverse decision by the Supreme Court of the United States, by forcing the utilities to agree to surrender all constitutional rights, and hereafter to be governed by whatever form of regulation the commission may choose to enforce.

"The decisions of the Supreme Court of the United States indicate, I believe, and evidently the commission also believes or it would not be so disturbed, that, in general, companies are entitled to a reasonable return on the fair value of their property and that the fair value cannot be determined without consideration of the reproduction cost of the property less depreciation.

"Whether or not this statement is correct will probably soon be decided by the Supreme Court of the United States in the O'Fallon case, which has now been appealed to the Supreme Court and which will soon be on the docket. Now this principle of determining value in the ordinary case by a finding of reproduction value less depreciation is no new thing. It was advocated in 1898 (a period of low prices) by William Jennings Bryan on behalf of the public. To all intents and purposes the principle has been accepted since by practically every commission in this country. The matter becomes important now and the dissent arises because there has been an increase in the general price level above the pre-war level. In other words, the index number is perhaps 40 per cent higher, so that so far as a utility has property which was installed prior to 1917 the utility would on the cost of reproduction theory have a valuation of 30 to 60 per cent in excess of cost of that part of its property. On property installed since 1919, which is the greater part of the existing investment of the utilities today, there has been no material change in the price level, and if conditions and price levels remain as they are and the growth of the utility continues, so far as the gas and electric industry is concerned this whole controversy will practically disappear in four or five years, because with the discarding of old property and the continued growth in new property investment the proportion of installation at pre-war prices is diminishing very fast.

"I will hazard an estimate that most electric companies in Massachusetts would under the reproduction theory receive credit for a rate base today of only between 10 and 30 per cent in excess of actual investment, depending on the amount of new property installed in the last ten years.

"In the opinion of some of the leading economists in the United States the reason for the so-called increases in value economically justifies reproduction cost as a rate base.

"You are familiar with the fact that prices have gone up since before the war, prices of labor and of commodities generally, and the underlying reason is the change in the purchasing power of the dollar. The laborer receives more wages, the apartment house owner receives higher rents; it does not make any difference whether the laborer was born before 1917 or whether the apartment was built before 1917. Is there any justification for saying that the investor in a public utility should have different treatment from an investor in any other form of industry? 'Prudent investment' is a very attractive phrase, but 'prudent investment' without equating to the diminished purchasing power of the dollar merely means that you are depriving the investor of some 40 per cent of his dollar, and the economist can show you that this is so.

"Men like Prof. Irving Fisher, Dr. Arthur Twining Hadley, Professor Cabot* of the Harvard Business School and other leading economists in the country believe that, in so far as property should govern rates, value should be determined on the basis of the reproduction theory, and Professor Cabot points out the dangers to the public of determination on any other theory, which can be phrased in a word, perhaps, by saying that if you pass the commission's bill, and a period of declining prices comes, the people of Massachusetts will be very regretful of this proposed contract. In other words, the commission would now attempt to transfer the risk of the enterpriser to the rate-paying public. I might just as well say tax-paying public, for the personnel are one and the same.

"The utilities believe that they are not only legally but economically justified in their position, and that to recede from this position would be submitting to confiscation of a very material part of the investment of the stockholder. The commission in its report to the Legislature refers to the greed and gluttony of the man who would introduce this principle into Massachusetts regulation, and I assume that the fellow conspirators of these 'gluttons' are the Justices of the Supreme Court of the United States who have apparently approved the reproduction doctrine, some of the leading economists of the United States who advocate it, and the utility commissioners of most other states of the Union who have adopted it.

"It is only recently that the suggestion was made that there is a different rule of rate making in Massachusetts than elsewhere; that suggestion has no foundation in law or in fact.

Penalty of Non-Acceptance

"Now, passing from the crime for which the utilities are to be punished, the crime of challenging the commission's decision in the federal courts, let us turn to the penalty. If the utility does not enter into a contract by which it submits to any kind of regulation which the commission may hand out municipal competition shall be encouraged, a competition which would be suicidal to both the competing municipality and the utility. The utility shall also be deprived of the power of eminent domain. It got along without the power of eminent domain for a great many years; this power was given it in order to cheapen the cost of service, and this has resulted. It shall be deprived of the power to issue further securities for plant expansion, which of course dries up the utility, impairs service, results in its eventual demise and entire loss to the investor. The bill is intended to prevent a utility from claiming constitutional rights of any description by forcing it at the point of a pistol to agree to give up its constitutional rights. It is

**Professor Cabot's argument will shortly appear in the* Electrical World.—Editor.

an attempt to nullify the Constitution of the United States by indirection, and as such it is an unconstitutional attempt.

"The commission's bill confiscates part of the investment and reduces the return. After certifying that its issue price was in the public interest, should the commission take this attitude toward the stockholders? I think any one would agree that the commission never should have made an order to put out stock at a level which it was unwilling to accept as a rate base, and may I suggest that, if this bill is passed, the commissioners in their capacity of regulating issues of securities under the blue sky law ought to investigate themselves in their capacity of regulating the issue price of securities, like the Lord Chancellor in 'Iolanthe,' who was compelled to find himself in contempt of court because he was in love with his ward in chancery.

"In the case of the Fall River Gas Works vs. Gas and Electric Light Comm., 214 Mass. 529, the court said:

> As between the public and the corporation the earnings belong to the corporation.

"The commission has for years recognized the surplus when it ordered issue of stock at a premium.

"The theory now is that if a company paid 7 per cent average and earned anything more it was a robber. Is this so? Was 7 per cent compensatory in the early days, when risks were believed large; was it compensatory during the panic of 1893 and the following years; was it compensatory during the depression in the early part of this century; was it compensatory during the Roosevelt panic in 1907, and thereafter; was it compensatory from 1914 to 1923, a period during a large part of which some of the best industrials in the country were paying 8 per cent and higher for borrowed money; was it compensatory during 1926, when some of the finest public utility securities in the country were selling on an earning ratio basis of over 7 per cent?

"The surplus of the companies is not to be named in cents per kilowatt-hour. It was accumulated in small fractions of a cent per kilowatt-hour, and in every moment of the company's history there has been a commission with power to control rates.

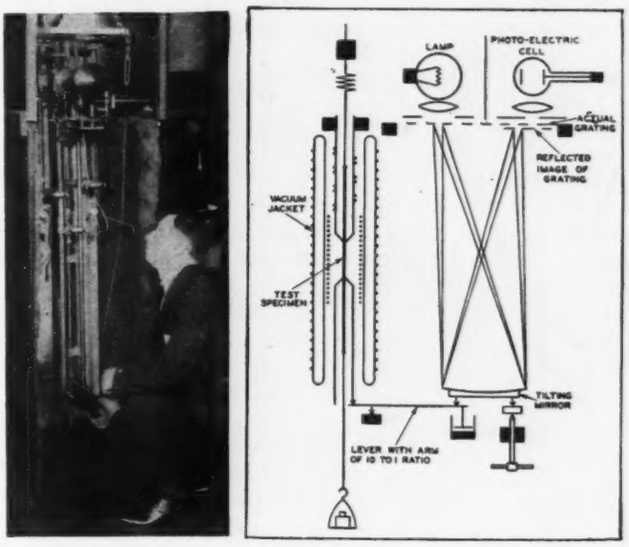
In Times of Depression

"But even if it is assumed that the assurance of a return sufficient to maintain the market value of stock at par is practical, and if beyond this complete good faith is presupposed and a practical guarantee is maintained, what happens? In times of economic stress and depreciated security values the rate of return will have to be increased to conform to the security market. In order to provide for this return, rates will have to be increased and the financial burden will thus be transferred directly and wholly from the investor to the rate payer, and in this connection it should be remembered that in times of economic stress unemployment is at its peak and the earning power of the average consumer is restricted. Just at the time when in the interest of the larger group of citizens conditions should be maintained with the greatest degree of stability, it will be necessary under the mandate of this bill to increase the rates and thrust the burdens upon incomes which have already been depleted.

"The history of the public utility industry has never presented a condition parallel to this. Rates have always been increased with great reluctance and the investors have never claimed their pound of flesh, but through the exercise of economy and forbearance have postponed, and in most cases avoided, rate increases in times of trouble. They are still willing to do as they have always done heretofore, and the vicious character of this bill is nowhere more apparent than it is in the case of the unnatural and uneconomic condition which it would impose upon the investor and the rate payer alike when adversity threatens."

Measuring Infinitesimal Elongation Electrically

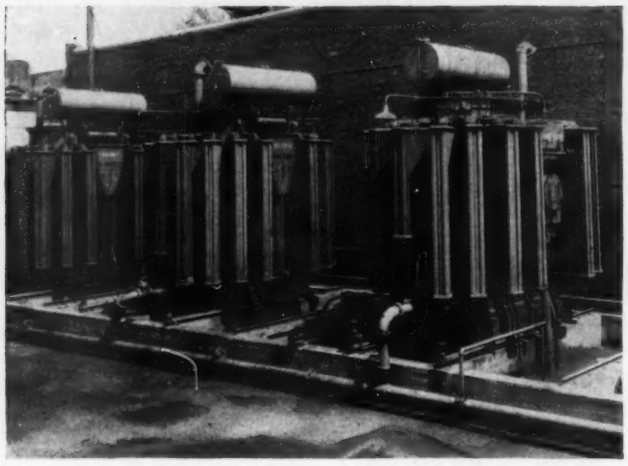
EQUIPMENT to measure changes in length of the order of a billionth of an inch has recently been devised by P. P. Cioffi of the Bell Telephone Laboratories. The need for so refined an instrument arose in studies of magnetic materials. It was designed to measure changes of length in a piece of wire about 4 in. long. One end of the 4-in. section is fixed in position and to the other end a clamp is attached which connects to the short arm of a lever. The long arm of this lever tips a concave mirror as the wire changes its length. Light from an incandescent lamp, after passing through a suitable lens, falls on the mirror at a small angle from



Arrangement and schematic plan of accurate measuring device

the perpendicular and is reflected back to a position somewhat offset from the lamp where a photo-electric cell is mounted. Between the light source and the mirror is a grating with alternate opaque and transparent lines, each ½ mm. thick. The image of this grating falls on the mirror and is reflected back to an extension of the same grating in front of the photo-electric cell. When the images of the transparent lines are reflected back to another group of transparent lines full light will fall on the cell. When, on the other hand, they fall on the opaque lines no light will be transmitted. Only a very small movement of the mirror is required to cause this change from full light to no light. The photo-electric cell gives off a current proportional to the light falling on it, and this current is indicated by a sensitive galvanometer. The galvanometer indication thus serves to divide the width of one bar of the grating into a large number of smaller divisions.

Exposed Buses Eliminated in Outdoor Substation



OUTDOOR equipment is reduced to a minimum by the Brooklyn Edison Company in this bank of 27,000/4,600, three-phase, 10,000-kva. transformer units. Three-conductor, underground, lead-covered cables for high- and low-tension connections run to oil-filled pot-heads on the sides of the transformers. Grounding switches are provided.

Costs for White-Way Lighting

ACCURATE operating costs for one year's operation of a white-way lighting system were kept by the serving utility to use as a basis for contracting for operation and maintenance on future installations. The system consists of about a mile of two-light standards using modern high-intensity lamps. Like many other cities, lighting installations of this character are paid for by the property owners by establishing an assessment district. Property owners also are permitted to contract for lighting and maintenance for a period of five years.

It is evident that the matter of operating costs is quite important to the central station, since any error in calculating these costs must be carried over a period of years before there is any chance of rectifying matters. Accordingly, the accompanying costs are presented in the hope that they may be of value to other central stations that are developing this type of load:

1. Cost of lamp replacements per light unit per year, labor and cartage only	$0.90
2. Average cost of lamp replacements per lamp per year, labor and cartage only	0.30
3. Cost of glassware replacements per light unit per year, labor and cartage only	0.05
4. Average cost of cleaning glassware per light unit per year (material, labor and cartage, six cleanings per year)	1.46
5. Average cost of cleaning glassware per light unit per cleaning	0.24
6. Average cost of patrolling and inspecting the installation per light unit per year (material labor and cartage)	0.38
7. Average cost of maintenance of posts, cut-outs and post base transformers per light unit per year (material, labor and cartage)	1.07
8. Average number of hours system was operated per light unit per year, lamp hours (one-third burn all night)	3,334
9. Average number of lamp renewals per light unit per year (one-third burn all night)	2.96
10. Distribution and transformer losses expressed as percentage of rated wattage of lamps	25

In studying this table it should be understood that the term "light unit" refers to the lamp and inclosing glassware. There are two such light units per post. It should be noted that in items 1, 2 and 3 the cost of lamps and glassware has purposely been omitted, since this factor varies with the lamp and glassware used, and may be accurately determined for any installation.

A very important point brought out by the cost study is the fact that the wattage assessable to each lamp as determined from the kilowatt-hours used by the system is 25 per cent greater than the rating of the lamps. This indicates that line losses and losses in the constant current transformers and series post transformers in this installation are somewhat higher than is generally assumed. This is an item of great importance where the service is sold on a predetermined value instead of on a metered basis.

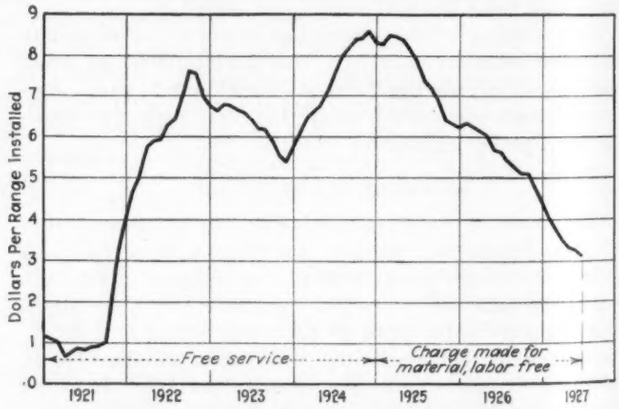
Range-Servicing Costs Mount Under Free Maintenance

By D. F. McCurrach
Rate Engineer Northwestern Electric Company, Portland, Ore.

SINCE the latter part of 1921 the power companies in Portland, Ore., have engaged actively in range sales and have built a large range load. Up to 1925 no charge whatsoever was made for servicing ranges, both labor and material being supplied free indefinitely. The effect of this practice was not fully appreciated until the cost of maintenance per range mounted to a serious figure, when both companies decided upon a change of policy to relieve them of the serious burden.

Under the new policy a range user is charged for all material used in maintenance, but still receives the labor free. A new customer has free maintenance for one year, the materials being furnished by the range manufacturer and the labor by the utility; after that a charge is made for material only.

The accompanying curve shows the average cost of range maintenance of the Northwestern Electric Company over the period covered by the different range-



Effect of range-servicing policies upon average maintenance cost per range

servicing policies. The salutary effect of the present policy as compared to the old is too obvious for reference.

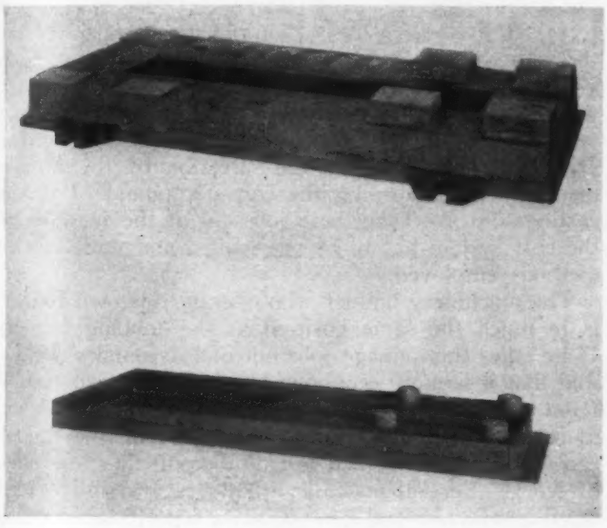
The cost of maintenance per cumulative average range installed is obtained as follows: The moving annual total range maintenance as of any particular month is divided by a figure which represents the cumulative number of ranges installed as of a year preceding the month investigated, plus one-half of the ranges installed in the current year. This method of showing the average maintenance cost has the effect each month of indicating in a general way the trend of these costs, as each calculation covers a year's operation.

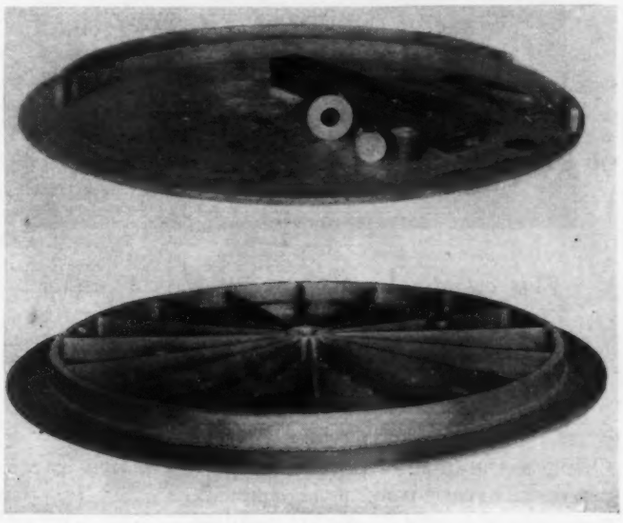
Arc Welding for Machinery

An analysis of the underlying factors governing the use of arc welding, with some examples of cost comparison with cast iron

By A. F. DAVIS
Vice-President Lincoln Electric Company

LIKE many other industrial processes that have been sponsored by the electrical industry, arc welding has spread into industry as a whole so that its significance to the electrical industry is small as compared with its significance to industry at large. Use of the electric arc for welding purposes was once an interesting novelty; today many people believe that electric arc welding is destined to bring about sweeping changes in American industry. The prophets of the welding fraternity are numerous and frequently make extravagant claims. Examination of the underlying factors that govern the use of welding may be helpful.





Comparison of costs between welded and cast-iron parts

Motor-Generator Set Base		Machinery Turntable Base	
Cast-iron base weight	560 lb.	Weight of rough casting	4,200 lb.
Cost	$31.70	Cost	$336
Welded steel equivalent weight	233 lb.	Weight of welded-steel equivalent	1,740 lb.
Cost	$7.45	Cost	$105

It is believed by many that the use of welded steel construction in place of castings is a serious threat to the foundry. It is claimed and adequately proved that a number of pieces of welded steel construction have been built that are the equivalent of castings, and cost figures are given to show that the welded steel costs only 25 to 50 per cent as much as the castings.

Does this mean that the foundries of the country are doomed? Engineers and executives who have had wide experience with welded steel construction say that the foundry is not doomed. J. H. Francis, vice-president and general manager of the Kilby Manufacturing Company, Cleveland, gives his view of the situation as follows: "We own and operate a gray-iron foundry. We also build a large amount of welded-steel construction. A considerable amount of the welded-steel construction is done on pieces which we formerly made in the foundry. The type of construction we use depends largely upon the job. Our responsibility to our customers compels us to manufacture our product as well as we can by the most economical process. Welded-steel construction has been built in our plant for thirteen years and we are doing more of it all the time. As yet, however, we see no indication that it would be a good thing for us to dispose of our foundry."

Advocates of welded-steel construction in place of castings have advanced the following as a sound basis for their claim that, where welded steel can be used, it is far less expensive than cast iron: Hot-rolled steel and gray-iron castings are both made from pig iron which costs about $20 per ton. Gray-iron castings cost, on the average, $120 per ton. The additional $100 per ton covers all the charges for molding, pouring and other foundry expense. The same ton of pig iron which cost $20 could have been made into hot-rolled steel for an additional $20 per ton, making a total cost of $40

a ton for hot-rolled steel. It costs five times as much to get a ton of pig iron into the form of a casting as it does to get it into the form of hot-rolled plates, shapes, bars, etc. The next step is to get the hot-rolled stock cut to size and welded into the equivalent of a casting. It is claimed that this cost on simple machinery bases and frames will in most cases not exceed $40 per ton. Thus the welded steel equivalent of the casting may cost $80 per ton, against $120 per ton for the casting.

This cylinder bracket cost less than a casting exclusive of the wood pattern cost

Weight	74 lb.
Material cost	$5.60
Labor cost	5.44
Equivalent rough casting cost	11.84
Wood pattern	30.00

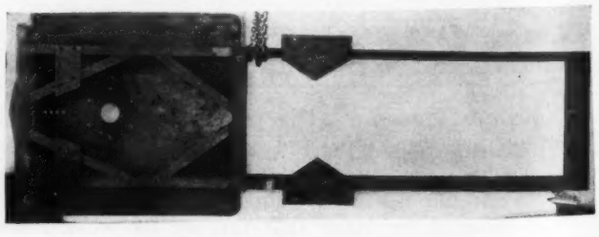
Owing to the superior physical properties of steel as compared with cast iron, it is claimed, usually less than one-half the weight of steel is required as compared with cast iron. The ratio of cost is therefore calculated to be, cast iron, $120; welded steel, $40.

It seems obvious from the preceding discussion that the importance of welded-steel construction and its effect on the foundry as well as industry in general is directly dependent on the percentage of castings that can be replaced with welded steel economically. On this point the testimony of I. T. Kahn, president of the Consolidated Iron & Steel Company of Cleveland, is interesting. The company operates the Republic Structural Iron Company, which, in addition to ordinary steel fabrication, makes welded-steel pieces in place of castings. The Consolidated Iron & Steel Company also owns and operates the Taylor & Boggis Foundry of Cleveland. Mr. Kahn sums up the situation as follows: "Operating, as we do, steel-welding equipment and a gray-iron foundry, we from time to time have to advise our customers the preferable construction for a given article and occasionally to suggest a change. It would seem that the idea of cost would be the determining factor, but this is not entirely so, and it is also true that a cost which may be favorable to welded steel, on a production of ten pieces per day, may be favorable to castings on a production of the same piece of 1,000 per day, or vice-versa. Appearance is important to American machinery manufacturers and users. Which of the two methods gives the better appearance? Generally the saving through the use of welded steel results from a reduction in weight, yet in many cases bulk or weight is essential in a certain member of the machine, which raises the question as to whether weight is essential to the design. Another question, which, however, is one of the components of cost, is the price of patterns for castings and the assembly jigs for welding. When these conditions are answered advantageously as to welded products, we recommend the change. As to the ultimate effect upon our foundry, we have no fear. Castings will not be discontinued and we believe anything that reduces the cost of machinery opens up new fields of consumption at each new level of reduced costs. Thus with a loss of such members as are changed to welded steel, the foundries will be compensated by increased production of the remaining unchanged members."

Present opinion among those who are in a position to judge the situation appears to warrant the belief that increasing use of welded-steel construction may necessitate some changes in the organization of the foundry industry. The foundry will hold the business which it can handle more efficiently than the welded steel department. But if the pieces of simple shape and in general the jobs which furnish the tonnage jobs of the foundry are to be built in welded steel, it means that the foundry will have to be organized to produce this class of work very efficiently. The tonnage jobs in the foundry are frequently looked on as the salvation of the foundry management in keeping the cost per pound of making castings down. Take these jobs out of the foundry and the cost system has to be overhauled and more efficient methods employed.

The machinery builder who operates his own foundry is in much the same position as the jobbing foundry. If he takes the tonnage jobs out of his foundry, he may find that it is more economical to buy the small castings from a foundry which is meeting the new situation with more efficient methods of producing small castings and can actually beat his own cost on the outside on this class of work. Several machinery builders who use welded-steel construction and also operate a foundry already face this situation.

The idea of welding in place of riveting does not carry



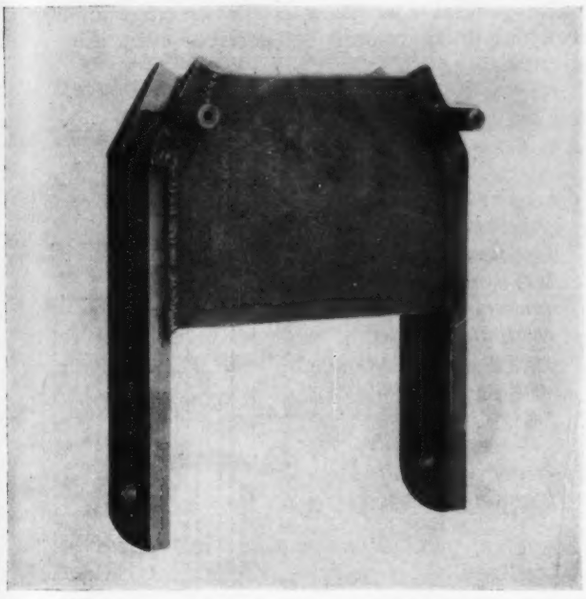
Welded steel power shovel base

Two-thirds the labor cost of riveting was saved by welding.

with it the implication of radical changes in iron and steel business such as may occur should welded-steel construction replace gray-iron castings on a large scale. No one appears to be very much excited about the question of whether steel shall be riveted together or welded together. The novelty of welding has worn off and the matter has become, to a considerable extent, a question of which method costs the more. There are of course, a

number of cases in which the judgment of the engineering profession is against the use of welding because it is relatively new and a great deal remains to be learned about it. High-pressure steam boilers, etc., can be welded but probably will not be welded until more is known about the process. However, this is but a matter of a short time, for we are making considerable progress in our knowledge of the process.

The grounds on which the advocates of welding base



This guide link of welded steel costs considerably less than a casting

Weight	90 lb.
Material cost	$5.08
Labor cost	0.85
Equivalent rough casting cost	18.00
Wood pattern	60.00

their claims to recognition on work which may be either riveted or welded are that there may be a saving of both material and labor. A material saving is claimed and in many cases proved on tanks, steel pipe and similar jobs, due to the fact that the welded joint may be as strong in tension as the members joined. The strength of the joint determines the thickness of material required on work of this kind. The riveted joint, on the other hand, is always weaker than the sections joined, so that an excess of material is required. The labor cost of joining steel pieces by welding is claimed to be less than the labor cost of riveting. The fact that the welding "gang" is one man and the riveting "gang" three or four men gives weight to the argument for welding. In shop welding there is general agreement that the work per day per man is far greater with welding than with riveting.

To summarize the whole situation relative to the use of welding, it may be said that in so far as welding may be used to fabricate jobs which were formerly made using castings or riveted steel, and produce an equivalent job at less cost, welding will be used. The conditions in the machinery building field which have been brought about by the application of arc welding are not unusual. The development of high-speed steel necessitated a much greater change in the design of machine tool equipment to meet the new high-speed and high-power conditions than may be expected in the case of introduction of welded-steel construction in place of castings.

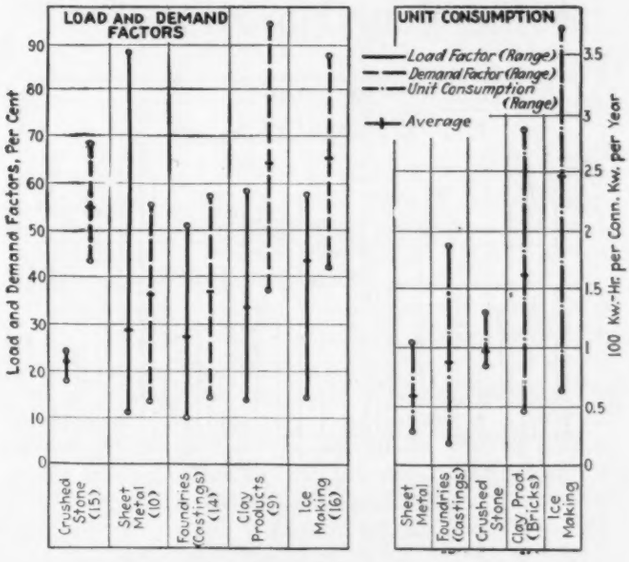
Characteristics of Industrial Loads

Performance of individual plants departs widely from averages. Useful data must be based on individual processes

EVERY now and then some one believes that considerable laborious investigation can be avoided in determining this or that factor if certain average electrical characteristics are obtained for different industries. For example, many commercial and engineering decisions could be made if the average load factor, demand factor or energy consumption per connected load for different industries were applied to individual plants in those industries. The question has been raised whether meter size might not be based on a certain percentage of the connected load.

While the general comment is often heard that every case must be considered by itself, it applies particularly to industrial characteristics. To show this fact 50 industrial plants representing five major classes of business were investigated to ascertain whether any average figures can be obtained for specific industries that mean anything.

Sixteen ice-making plants, fourteen foundries, ten sheet-metal factories, nine brick plants and five stone crushers were studied. The results are plotted herewith by group and relativity. Since they do not include small installations and apply to industries in one locality, the



Comparisons of average yearly load factors, demand factors and unit energy consumptions for different industries with departures from averages

individual results should approach the averages if they will under any condition.

A glance at the charts representing the separate industries indicates how widely the individual factors vary from the average, the departure being greater with some industries than with others. The master chart comparing load and demand factors and unit consumption for these five industries appears on this page and shows the same things a little more clearly than do the charts for each industry.

For example, load factor* (yearly) variation is least for crushing stone and greatest for sheet-metal working, departures from average for foundries, brick plants and ice making being as much as +87, —70; +75, —60; +35, —65 per cent of average respectively.

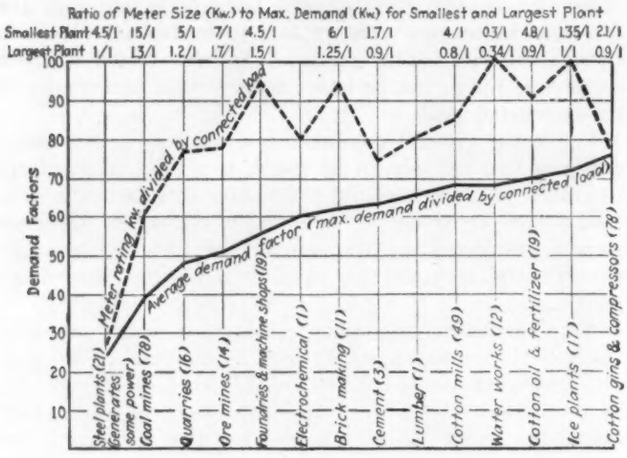
Likewise, demand factor* (yearly) variations are least for crushing stone and greatest for the other industries considered. Similar remarks can be made regarding kilowatt-hour consumption per connected kilowatt per year.

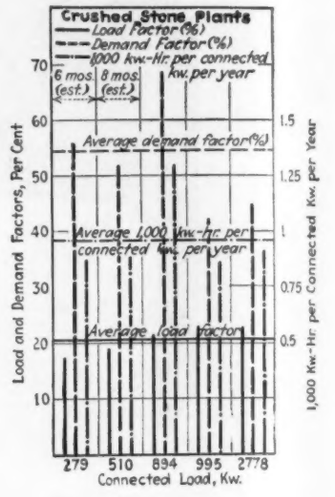
**Load factor and demand factor are loosely used frequently. They are used here with their standard meaning. For example, load factor is the ratio of average power to maximum power. Demand factor is the ratio of maximum demand to connected load.*

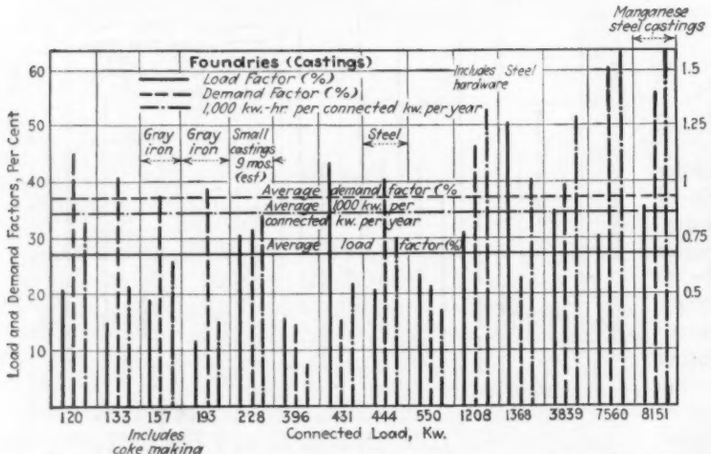
If averages mean anything when the departures are so great as those observed, it can be said that ice making has the highest load factor, demand factor and energy consumption per connected kilowatt. Of the remaining industries, brickmaking, sheet-metal plants, foundries and stone crushing rank in descending order for load factor. Brickmaking, stone crushing, foundries and sheet-metal plants rank in the order named for reduction in demand factor and energy consumption per kilowatt of connected load.

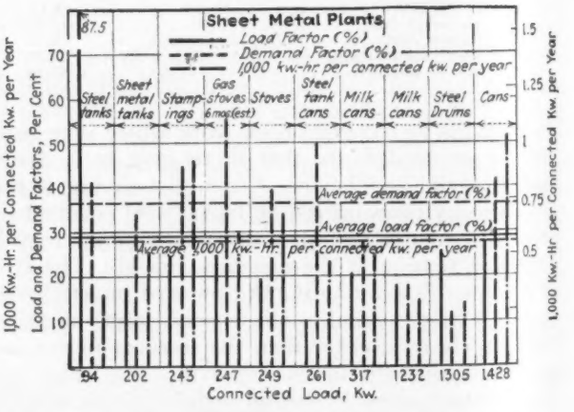
The general conclusion is that average figures that mean anything cannot be derived even for specific industries.

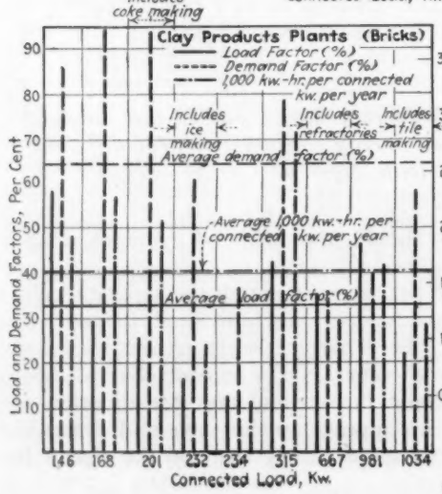
Comparisons of yearly load factor, demand factor, unit energy consumption and relations of meter size to connected load and demand factor for different installations engaged in similar occupations

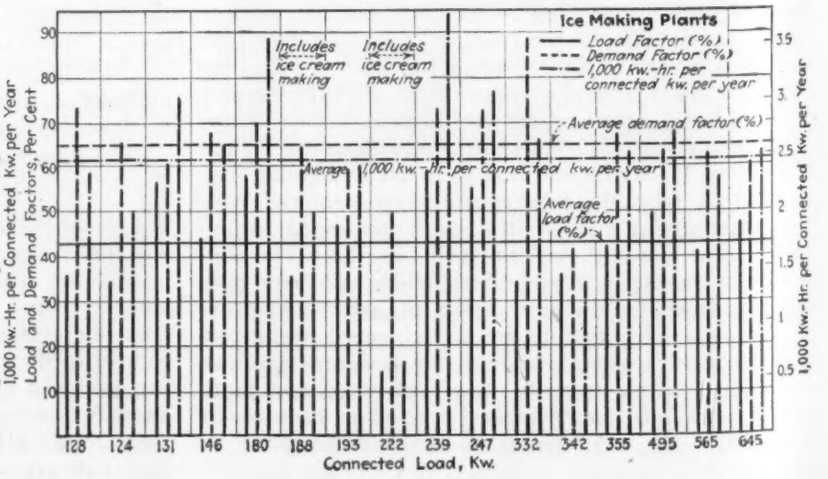

Ratio of Meter Size (Kw.) to Max. Demand (Kw.) for Smallest and Largest Plant
Smallest Plant 4.5/1 15/1 5/1 7/1 4.5/1 6/1 1.7/1 4/1 0.3/1 4.8/1 1.35/1 2.1/1
Largest Plant 1/1 1.3/1 1.2/1 1.7/1 1.5/1 1.25/1 0.9/1 0.8/1 0.34/1 0.9/1 1/1 0.9/1
Demand Factors
Meter rating (kw. divided by connected load)
Average demand factor (max. demand divided by connected load)
Steel plants (21)
Generates some power
Coal mines (78)
Quarries (16)
Ore mines (14)
Foundries & machine shops (19)
Electrochemical (1)
Brick making (11)
Cement (3)
Lumber (1)
Cotton mills (49)
Water works (12)
Cotton oil & fertilizer (19)
Ice plants (17)
Cotton gins & compressors (78)


Crushed Stone Plants
Load Factor (%)
Demand Factor (%)
1,000 kw.-hr. per connected kw. per year
6 mos. (est.)
8 mos. (est.)
Average demand factor (%)
Average 1,000 kw.-hr. per connected kw. per year
Average load factor
Load and Demand Factors, Per Cent
1,000 Kw.-Hr. per Connected Kw. per Year
279 510 894 995 2778
Connected Load, Kw.


Foundries (Castings)
Load Factor (%)
Demand Factor (%)
1,000 kw.-hr. per connected kw. per year
Includes Steel hardware
Manganese steel castings
Gray iron
Gray iron
Small castings 9 mos. (est.)
Steel
Average demand factor (%)
Average 1,000 kw. per connected kw. per year
Average load factor (%)
Load and Demand Factors, Per Cent
1,000 Kw.-Hr. per Connected Kw. per Year
120 133 157 193 228 396 431 444 550 1208 1368 3839 7560 8151
Includes coke making
Connected Load, Kw.




Clay Products Plants (Bricks)
Load Factor (%)
Demand Factor (%)
1,000 kw.-hr. per connected kw. per year
Includes ice making
Includes refractories
Includes tile making
Average demand factor (%)
Average 1,000 kw.-hr. per connected kw. per year
Average load factor (%)
Load and Demand Factors, Per Cent
1,000 Kw.-Hr. per Connected Kw. per Year
146 168 201 232 234 315 667 981 1034
Connected Load, Kw.


Ice Making Plants
Load Factor (%)
Demand Factor (%)
1,000 kw.-hr. per connected kw. per year
Includes ice cream making
Includes ice cream making
Average demand factor (%)
Average 1,000 kw.-hr. per connected kw. per year
Average load factor (%)
Load and Demand Factors, Per Cent
1,000 Kw.-Hr. per Connected Kw. per Year
128 124 131 146 180 188 193 222 239 247 332 342 355 495 565 645
Connected Load, Kw.

Unusual Street Lights for Los Angeles

AN ARTISTIC street lighting system has been designed for Wilshire Boulevard, Los Angeles, by the General Electric Company. The lighting units, or lanterns, are larger than previous designs for this type of service. They are, in general, rectangular in shape, approximately 7 ft. high and are mounted on poles to bring the light center 22 ft. above the street. Each lantern contains two incandescent lamps, one 2,500 cp. and the other 600 cp.

A double wiring circuit will make it possible to operate either lamp separately or both together. It is intended to use the brighter lamps from darkness until midnight and the smaller lamps from midnight until daylight, when traffic on the street will be so light as not to require as much illumination. Approximately 400 of the new lights have been installed 120 ft. apart on either side of the street. The poles are of bronze-sprayed cast iron and the lanterns of cast bronze. In accordance with the general popular vogue in southern California of using the Spanish renaissance design for much of its street architecture, this style has been followed in the design of the lanterns and standards.

Utility Finds Opportunities for Economies in Many Departments

CONVINCED that continuous thinking in terms of economy and adopting a policy of undeviating vigilance will bring results, a public utility supplying a city and suburban community in the East has applied its theories in practice.

The end of the construction, or expansion, period in the territory of this company permitted the reduction in number of workmen in the construction department from 105 to 15. This eliminated a large labor item, and the maintenance work was scheduled and arranged so that a minimum number of workers are now required for this class of activity.

Passenger automobiles formerly assigned to individuals for their exclusive use have been numbered and are now used as taxis—that is, are operated when needed, by any employee privileged to car use. This resulted in a reduction in the number of vehicles needed from twenty to fifteen, with a consequent curtailment of overhead and operating expenses. Standardization of motor vehicles, both passenger and commercial, eliminated a great multiplicity of spare tire, parts and tool requirements and permitted shop storage space curtailments. The value of eliminating assigned cars was believed to be largely psychological, offering a means of inducing employees to think of their activities in terms of economy.

Combination of the functions of the underground forces of the electric and gas divisions made one supervisory organization serve for both. Working crews were consolidated so that any truck can service either class.

Record-department complexity was reduced. Where formerly seven sources of information and records on meters and customers, accounts were maintained, there will be two files for this purpose. A saving in floor space of about 10,000 sq.ft. was realized and a contemplated expenditure for expansion which would have involved $7,000 to $8,000 was avoided.

A recent survey of consumers' homes indicated that about 12 per cent of the fixture outlets were not provided with lamps. A successful campaign for the sale, at an attractive price, of packages containing six lamps resulted in placing more than one additional lamp per customer in the hands of consumers in this territory.

Sales efforts added refrigerators to the lines and the recommendations of satisfied users have led to a market out of proportion to the direct sales efforts. Similar comments can be made regarding other appliances.

Changing from arc equipment to incandescent street lamps to reduce maintainance charges and replacements has converted the net results from a loss per installation per year to a reasonable profit.

Interconnection with adjacent electric light and power systems is considered to have reduced the value, as essential operating units, of the individual power station comprising this company's generating capacity. As the necessity of the individual unit for service continuity maintenance is reduced and some of them are not required for stand-by service in the event of breakdowns, fewer small stations must be maintained. Interconnection has, in addition to reducing the capital investment required for generating purposes, resulted in better service and higher reliability. The number of operators was found to be greater than necessary, after the completion of the interconnection program, and the services of 30 men were dispensed with.

This company has found that there are opportunities in nearly every department for making the invested dollar work harder, longer and more effectively.

Letters from Our Readers

Value of Purchased Power

To the Editor of ELECTRICAL WORLD:

The attention of ELECTRICAL WORLD readers should be called to a miscalculation by Edgar J. Kates in the Feb. 14 issue of *Power*, where he discusses "Guessing Fixed Charges for a Proposed Power Plant."

He assumes an industrial establishment using 17,000 kw.-hr. per month with a maximum demand of 100 kw. and a Diesel engine operating cost of 1.1 cents per kw.-hr. This gives an operating cost of $187 per month. Then he proceeds to say that purchased power costs 2.28 cents per kilowatt-hour, or $476 per month. My arithmetic makes this only $387.60 per month. This is a serious error. Mr. Kates assumes an investment of $15,000 necessary to produce the above results.

If this industrial plant put the $15,000 in a safe investment at 6 per cent it would make $900 per year, or, better still, if put back into its own business probably three or four times this amount. Furthermore, ten years is a long time and this industrial plant will probably have lower power rates before that, or at least it will want to have $15,000 ready to buy a better oil engine; $900 plus $1,500 is $2,400, equaling the amount of the assumed saving. Also, the plant would probably not have maintenance and other troubles to worry about.

It looks as if Mr. Kates has made about a $20,000 error.

L. O. BUCKNER.

York, Pa.

[The rate upon which the calculations of Mr. Kates were based was 2.8 cents; the figure of 2.28 was a typographical error, according to the editor of *Power*.—EDITOR.]

Digest of Electrical Literature

Generation, Control, Switching and Protection

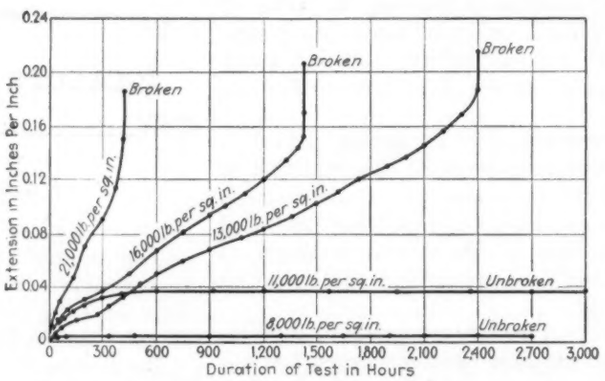
Transformer Protection.—V. WIARDA and E. WILM.—An overwhelming majority of transformer faults are accompanied and preceded by abnormal heating of the oil. Over-current protection cannot function until the fault has developed to such magnitude as to cause a material increase of the normally absorbed current. A gas relay, on the other hand, fails to respond until the abnormal heating is high enough to dis sociate oil or to cause an arc. A well-designed temperature relay of high thermal sensitiveness is therefore considered by the authors as superior to either of these two. Two such relays of recent design are described. Both of them utilize the bending of a bimetallic strip. The disadvantage of the slowly moving strip, combined with the uncertainty of making a reliable contact, has been avoided by causing the strip to release a lever, subjected to heavy spring pressure, thereby obtaining a positive snap-action switch. The strip, adjusting screw, spring switch and resetting lever are mounted in a 1-in. insulating tube, which can be screwed oil-tight into cover or tank of a transformer. Adjustment is provided for a range of 50 to 120 deg. C., within an accuracy of plus or minus ½ deg. This relay was adopted as standard equipment on all power transformers of the Berlin municipal power system. — *Elektrotechnische Zeitschrift,* Jan. 19, 1928.

Transmission, Substations and Distribution

Heavy Traction Substations.—H. B. POYNDER.—A practical consideration of some of the problems encountered in the design of automatic rotary convertor equipment which still await satisfactory solution. The author has considered the circuit breakers, ventilation, thermal relaying and vertical versus horizontal design for rotary convertors. The advantages of high-speed circuit breakers are stated as including the prevention of serious lightning trouble on the track equipment. It is the contention of the author that breakdowns which occur during thunderstorms are in almost all cases caused by surges set up by lightning strokes in the vicinity of the track which do not actually strike the equipment. The initial discharge amounts to only a relatively small number of coulombs, is practically harmless so long as it takes place over the surface of the insulators and does not pierce them, and this can be insured by proper design of the insulators. The damage results from the great heat generated by the power arc which follows, and the high-speed breaker, by limiting the time during which the power arc persists, prevents any damage to the insulators in the great majority of cases. The author is strongly in favor of the development of an overhung vertical machine with a central bearing and a steadying thrust bearing below, the slip-rings being between the two bearings. This is advocated as producing a compact design with magnet ring resting on the substation floor and the slip-rings in the basement. The accumulation of conducting vapor would be impossible, there being in the suggested design a free upward path for all conducting vapors.—*Electrical Review (England)*, Feb. 10, 1928.

Hydro-Electric Development and Steam Equipment

What is the Limiting Temperature in Central-Station Operation?—V. T. MALCOLM.—As a result of investigation the author states that at each temperature of a metal under test there is a stress which if exceeded will cause fracture, though equipment may give satisfactory service operating at this temperature with loads greater than the critical stress for many years. The best conclusions indicate that the design of equipment must be based upon the strength of metals at operating temperatures over long periods of time and that other properties, such as thermal expansion, thermal conductivity, chemical stability, resistance to wear and abrasion, etc., must receive greater attention than in present engineering practice. These latter factors will probably govern actual design, but the first and basic requisite is that of physical strength and the proposed temperature. Charts for various alloys considered by the author to be safe for operation at 1,000 deg. F., and which are also satisfactory for such service as requires wear resistance, chemical stability and coefficient of expansion, are given. The physical properties of metal suitable for high temperature service have been reviewed in connection with creep values, chemical stability, thermal expansion and wear and abrasion factors.—*Mechanical Engineering,* February 1928.



Creep tests on cast chrome-nickel steel, at constant temperature (1,000 deg. F.) and load

Units, Measurements and Instruments

Absolute Measurement of Capacitance by Maxwell's Method.—HARVEY L. CURTIS and CHARLES MOON.—The absolute measurement of capacitance by Maxwell's method is based on the assumption that certain conditions are fulfilled by the experimental apparatus. While there are at least seven of these conditions, the most important is that the galvanometer correctly integrates the current. When large capacitances are measured, a galvanometer is required in which the current through the coil does not affect the magnetism of the permanent magnet. By placing the coil in a symmetrical position with respect to the magnet this condition can be fulfilled in most galvanometers. This adjustment is, however, greatly simplified by a proper design of the galvanometers. The method used by the present investigators requires that a condenser shall be charged and discharged at a known rate. This is accomplished by platinum contacts dipping in mercury cups which have been placed on the prongs of a tuning fork driven by an electron tube. This permits the Maxwell bridge to be balanced with the same ease and accuracy as a Wheatstone bridge. It is necessary to determine the frequency of the fork at the time of measurement. The possibility of introducing systematic errors has been guarded against by employing two independent bridges in which the factors have been varied as much as possible.—No. 564 *Scientific Papers of the Bureau of Standards.*

Illumination

An Investigation of Electric Lighting in the Engineering Industries.—J. L. H. COOPER.—The modern trend toward standardization in industry has resulted in attaining a degree of workshop efficiency not hitherto available and it is now realized that the prosperity of all industrial establishments depends to a large extent on the adoption of standardized systems for lighting in workshops, and in contrast to the earlier lighting systems much more attention is now given to illumination

and the arrangement of lighting units. The author has reviewed the general attitude of employers in Great Britain in regard to lighting, the activities in connection with more progressive lighting policies. The average hours of artificial lighting are tabulated in connection with significant factors of wall conditions and window conditions, and work requirements, the servicing and maintenance of lamps and equipment, the types of lamps employed, glare factors, types of buildings, lighting of machine tools, tabulated values for tool point intensities and general intensity values have been given. The author states that it is not generally appreciated that the cost of lighting in the average workshop represents a very small percentage of other charges when one considers the payroll and capital charges. In general, the cost of good lighting both in large and small workshops does not exceed 0.86 per cent of the wages bill. The cost, therefore, of good lighting cannot be considered as a burden on industry, but on the contrary is economically sound and efficient.—*Journal of Good Lighting (England)*, January, 1928.

Motors and Control

Accurate Control of Rolling Speeds.—The electrically driven 10-in. merchant bar mill recently installed in an Ohio plant has unusual provisions for close regulation of rolling speeds. As a result, less frequent roll changes are necessary. It is unnecessary to maintain close supervision of roll diameters, as is required with constant-speed drives, because the speed of the stand may be increased to compensate for alteration of the roll diameter. Roll changes are unnecessary for sizes from $\frac{7}{32}$ in. to $\frac{5}{8}$ in. in round bars or equivalent sections in squares and flats, according to this article. Each mill motor has an individual magnetic control panel so that any stand can be started or stopped. When each of the stands is driven at the proper speed the bar passing through it is kept under tension but not stretched or looped. Because of the close centers, speed is controlled by a synchronous tie between the motors, which in reality takes the place of interlocking gears. This control is obtained by individual balance-type vibrating speed regulators which not only maintain a synchronous tie among the four motors but also maintain a correct speed set for each motor within close limits. This speed-regulating equipment may be taken out of service by the operation of a transfer switch and the motor placed under hand control.—*Iron Age*, Feb. 2, 1928.

Electrically Driven Woodworking Machinery.—Various aspects of the direct electric drive, with particular reference to high-speed equipment made possible by the application of high-frequency alternating-current motors, have been considered in this discussion. Tabulated recommendations of countershaft speeds and motor sizes and ratings for use in connection with the more common types of woodworking machinery have been included. The use of portable electric tools in certain jobs has also received consideration, with particular reference to the speeds found desirable for standardized specifications.—*Electrical Review (England)*, Feb. 3, 1928.

Electrophysics, Electrochemistry and Batteries

Electric Puncture of Two Dielectrics in Series.—E. MARX.—If two insulating media of greatly different electric strength are placed in series, and are subjected to a puncture test, it will be found that the failure of the weaker material reduces materially the strength of the other, stronger, material. The partial breakdown acts like a sharp point, concentrating the electric field and causing a premature failure of the other insulator. The tests were made first between electrodes immersed in distilled water, with a sheet of Cellon half way between the electrodes. It was found that the polarity is considerably influenced by direct-current tests. Similar characteristics were found with porcelain or glass in oil. For example, a certain oil-porcelain-oil combination failed at 77 kv., while the porcelain piece alone did not puncture until 136 kv. Since such combinations of dielectrics are commonly used in oil switches, transformers and other oil-immersed high-voltage apparatus this phenomenon should be of considerable value to designers.—*Elektrotechnische Zeitschrift*, Jan. 12, 1928.

Traction

The Post Office Railway—A discussion of the underground electric railway for the conveyance of letter and parcel mails between the principal post offices and railway stations in London. This system has recently been opened for traffic and a description of the electrical layout and equipment is included in this article. The total length of the railway as at present constructed is 6½ miles. Operation of the trains is entirely independent of any accompanying motorman and control is obtained through switch cabins at each station. The rolling stock consists of steel cars which are made up into trains of two or three units. Each car is capable of carrying a load of 1,120 lb. The electrical equipment is relatively simple and consists principally of two 22-hp., 440-volt direct-current series motors connected in parallel. A resistance in series with each motor and a set of electrically operated braking equipment and reverse gear are mounted on each car. The motors are energized in the usual way from the conductor rail, which is divided into sections, each section being controlled either by an automatic track circuit on the sections between the stations or by levers working under track circuit control in the station areas. These levers are concentrated in the various switch cabins. The train is started on a falling track gradient under a pressure of 440 volts and attains a maximum speed of 35 m.p.h. When a station is approached and a rising gradient is encountered the conductor rail is dead and the train is brought to rest by the automatic operation of the brakes. After a short interval the conductor rail in this section is energized at 440 volts and remains energized at that voltage for a predetermined time, which is sufficiently long to give the train a good start. At the end of this period the voltage is reduced to 150 and the train runs into the station under these conditions. Here it either enters a dead berth section and is brought to rest by the brakes alongside the appropriate platform or it passes on to a through section if it is not to stop at the station.—*Electrician (England)*, Feb. 10, 1928.

Miscellaneous

Physical and Optical Societies' Exhibition.—Electrical instruments were a feature of the eighteenth annual exhibition of the physical and optical societies recently held in London. Several types of unusual interest were included. An improved oscillograph outfit suitable for potentials up to 75,000 volts includes two electromagnetic vibrators and one electrostatic vibrator, which may be used to obtain voltage records at very high pressures through variation of equipment characteristics. This device requires but one camera and one source of light to which an abnormal voltage is applied for a fraction of a second during the time of exposure. The intense light thus obtained passes through an optical system, which insures that a separate beam is focussed on each vibrating mirror. The reflected beams pass through a cylindrical lens, thereby reducing the images to bright spots of film, which is moved in a vertical plane at right angles to the plane of the vibrating beams. Another exhibit was a low-tension Schering bridge of improved design, which provides a simple and accurate means of measuring the power factor and dielectric constant of insulating materials at audio-frequency. Provision is said to have been made for measuring power factors from 0.001 to 0.5 with test capacities varying from 50 to 1,000 micro-microfarads. The electrodes and leads are screened so that samples may be tested at a controlled temperature and humidity. The bridge is direct reading and easy to operate. A heat-loss gage, which may be carried in the hand and used at the desired point, has been devised for measuring the heat loss from a surface of boiler settings and other hot bodies. The surface of a capsule is exposed to the heat emanating from the surface under test, either by making direct contact with the surface or by holding the instrument at a distance, when the radiant heat is measured. The instrument's heat receiving surface is surrounded by a guard ring.—*Engineer (England)*, Jan. 12, 1928.

Book Reviews

English for Engineers

By S. A. Harbarger, assistant professor of English Ohio State University. New York: McGraw-Hill Book Company, Inc. Second edition. 300 pages. Price, $2.

"English for engineers, or 'engineering English' as it is popularly called, should mean the presentation of ideas from the engineer's angle, the interpretation of ideas as he sees them with his interest, his training, his ambition and his vision." With this definition, the author, in a manner at once succinct and comprehensive, gives many practical hints concerning the way in which the engineer should approach writing of every description—sales matter, business letters, letters of inquiry and instructions, technical explanations, abstracts, summaries, reports, book reviews, editorials and articles for engineering societies and publications. A chapter is also included on "English for Non-Technical Uses." College students and young engineers should find in the book an incentive to care and pains whenever they put pen to paper. Practice is nine-tenths of style; but great engineering writers are few, and it is doubtless as unreasonable to expect an accomplished engineer to be also a brilliant author as it would be to expect a master of composition to excel as a technician. Every engineer, however, can shun the errors of the illiterate and the jargon of the marketplace. Professor Harbarger's effort is rightly and well directed.

Anleitung zur Entwicklung Elektrischer Starkstromschaltungen

By Dr.-Ing. Georg I. Meyer. Berlin: Julius Springer. 159 pages, 167 illustrations.

The usefulness of this book lies in its affording a basis for building up switching schemes to fit various conditions as they may confront the engineer. It does not offer ready-made solutions, and it is confined to power circuits. As might be expected, the major portion is devoted to polyphase control, with its diversity of possible connections, relays and protective devices. Liberal use is made of schematic diagrams. Bold lines and separate figures to focus attention on one item at a time contribute to the clarity of treatment, which is essentially descriptive, dealing with methods, rather than devices.

Der Transformator im Betrieb

By Dr. Milan Vidmar. Berlin: Julius Springer. 310 pages, 126 illustrations.

The author's avowed object is to reconcile the viewpoints of operating engineer and designer by discussing the economics and the functioning of transformer installations under unusual as well as under normal conditions. Thus, he points out that under pressure of price competition the effect of technical progress is inevitably and progressively to decrease the efficiency. The inclusion of analyses of the functioning of protective devices—e.g., fuses, circuit breakers, lightning arresters and choke coils—in their bearing on thermal and mechanical phenomena within the transformer is commendable. The treatise sums up transformer performance in a readable and authoritative way, somewhat off the beaten path and avoiding excessive use of mathematical language.

Wissenschaftliche Abhandlungen der Physikalisch-Technischen Reichsanstalt

Berlin: Julius Springer. Vol. X, Parts 1 and 2, 363 pages; Vol. XI, Part 1, 336 pages.

The general quality of these reprints of contributions from the Reichsanstalt to various scientific and technical journals is too well known to call for comment. They are not confined to any one branch of physics. Space unfortunately does not permit even a catalog of titles of those relating to electricity or using interesting electrical methods. Photometric and optical studies appear in considerable number; others deal with high-frequency or high-intensity electrical and magnetic measurements, including mention of an oscillograph serviceable up to 50,000 cycles p.s., low-temperature conductivity of metals and crystals and platinum resistance thermometric calibrations, measurement of low thermal conductivities, color methods for temperatures of small coils, a condenser method for measuring bearing lubrication and a unit for Roentgen ray dosage. There is a lengthy report on the calibration of mercury standards of the ohm.

Landeselektrizitätswerke

By S. Schönberg and E. Glunk. Munich and Berlin: R. Oldenbourg. 398 pages, 144 illustrations.

This comprehensive treatise by former associates of the late Oskar Miller deals with superpower systems in general, although the illustrations are largely drawn from the great Bayernwerk. The authors take up in considerable detail various stages in the development of a large regional undertaking, giving due attention to economic as well as engineering considerations. The units are necessarily the local systems, which must be co-ordinated into a single entity. Among the topics discussed are the estimation of the probable demand, the obtaining of data by means of suitable questionnaires, the predetermination of the future lighting, industrial and transportation loads, determination of the sites and magnitudes of hydro-electric and steam stations to be constructed, the securing of an economic balance between the two sources of energy, and finally the working out of the major engineering features. The book contains a profusion of tables, charts and diagrams.

Die elektrischen Einrichtungen für den Eigenbedarf grosser Kraftwerke

By Friedrich Litze. Berlin: Julius Springer. 160 pages, 89 illustrations.

Power plants, both steam and hydraulic, have grown to such magnitudes and in modern practice make use of so many automatic features that a great deal of electrical apparatus is necessary to the plants' own functioning, as distinguished from the main equipment for the generation and control of the outgoing energy. The author states that no unified treatment of this auxiliary equipment has heretofore been published. The book undertakes to make up the deficiency in a descriptive way. While useful as a summary of modern practice, its value would be greatly enhanced by the inclusion of quantitative information.

Die Grundlagen der Hochfrequenztechnik

Br. Dr.-Ing. F. Ollendorff. Berlin: Julius Springer. 639 pages, 379 illustrations, three insert charts.

The author has successfully put into a single volume enough of the underlying theory of high-frequency engineering to serve as an adequate introduction to practice, if combined with a reasonable amount of suitable laboratory work, or if the reader is already familiar with the devices and fundamental circuits. The book was developed for a course in a German technical school of recognized standing. That will suggest the scope and grade of difficulty. The treatment is necessarily mathematical, though not obtrusively so, and the physical significance of the conclusions is pointed out. In general, it follows established lines: the first third devoted to the characteristics of static and dynamic fields and of the parts constituting the usual high-frequency circuit, the next part to circuit characteristics, forced and free oscillations, coupled circuits and related topics, and the final quarter to electromagnetic radiations. To the teacher or advanced student, especially in the field of communication engineering, it should prove useful for both the text and for the copious bibliography. Even so, the latter is not exhaustive, at least in so far as American titles are concerned.

Books Received

Hockspannungs freileitungen. By Dr.-Ing. K. Draeger. Berlin: Julius Springer. 40 pages, illustrated.

Die Gleichstrommachine. By Dr.-Ing. e. h. J. L. la Cour. Berlin: Julius Springer. 714 pages, illustrated. Price, 30 marks.

Radio Engineering Principles. New second edition. By H. Lauer and H. L. Brown. New York: McGraw-Hill Book Company, 301 pages, illustrated. Price, $3.50.

News of the Industry

Senators Chatter, Chatter as Words Flow

And Muscle Shoals Debate Goes on Forever—House in a Snarl on the Same Subject—Trade Commission Questionnaire—Boulder Dam "Facts"

By Paul Wooton
Washington Correspondent of Electrical World

DESPITE all that has been said in Congress in the past ten years about Muscle Shoals, that subject continues to stimulate protracted debate. A vote on the Norris resolution has been expected in the Senate for more than a week. As this is written, there are indications that the debate may continue for another week. It is very apparent, however, that the Norris resolution, modified by the Harrison amendment, stands a good chance of passage. In the Lower House, Muscle Shoals is in a worse snarl than ever, with the prospects against any legislation.

The Harrison amendment puts the government in the fertilizer business on an experimental basis only. While there is objection to even a small commercial production, it comes apparently from a minority. On the other hand, there is some objection from those who want to see the government become a large producer of commercial fertilizers. The majority, however, seems to think the Harrison amendment does everything for fertilizer that reasonably can be expected. The strength of the amendment lies in the fact that it removes the undesirable feature of government operation from the disposition of the power output. Under it the power must be distributed under state regulation, without discrimination among states and municipalities. Moreover, it prevents municipalities from securing power under conditions that would permit discrimination against the users of power who make their purchases through ordinary commercial channels.

The Federal Trade Commission is making its final arrangements for its hearings in the investigation of the electric and gas industries. It is stated at the offices of the commission that the utilities are co-operating to make the investigation a thoroughly efficient one. So as to obtain certain fundamental data which will aid in the conduct of the hearings, it is understood that the commission is about to send out a carefully prepared questionnaire to the industry. All the subpœnas now have been issued to take care of the initial hearings.

Instead of the private conference at first planned, preliminary hearings were held by the commission on Thursday morning of this week to examine certain officers and representatives of the National Electric Light Association and the American Gas Association. Testimony was to be taken with a view to identifying and putting in the record certain documents of the two associations relating to their organization and personnel. No announcement was made as to when other public hearings in the investigation will begin.

Boulder Dam "Facts"

A detailed examination of the Swing-Johnson Boulder Dam bill, with suggested changes, is made by the Secretary of the Interior, Hubert Work, in a letter to Senator Phipps, chairman of the committee on irrigation and reclamation. It concludes:

To sum the matter up, it is my opinion that the entire $125,000,000 proposed to be authorized to be appropriated from the Treasury for this project should be reimbursed, with interest. The information available to the department seems conclusive that the entire expenditure can be paid out of power and other receipts without imposing any undue burden on any feature of the project or those to be benefited thereby. Apparently, the only effect of any donation of a part of such principal or interest would be to increase the suggested contributions to the States of Arizona and Nevada. The plan set out in Section 16 for the construction of a so-called retainer dam for flood control with foundations sufficient to permit the later construction of a dam 550 ft. in height, I do not regard as feasible. In my judgment, the sum mentioned would not be sufficient to construct a dam sufficient to afford flood protection of material value.

The eleven members of the California delegation in the House of Representatives have issued and signed a "statement of facts" regarding the Boulder Dam project. It is as follows:

1. There is a serious and ever-increasing flood menace existing along the lower reaches of the Colorado River, both in Arizona and California, threatening the destruction of lower basin communities, the largest and most important being the fertile and productive Imperial Valley, with its 65,000 inhabitants, all below sea level.

2. A high dam at Boulder Canyon will hold back the floodwaters of the Colorado River and prevent a recurrence of the disasters of the past. This remedy has been worked out by the government engineers after thorough, exhaustive investigations and studies and has been favorably recommended to Congress by the Secretary of the Interior. Eminent engineers outside of the Interior Department have concurred in and approved the works, plans and cost estimates of the Reclamation Service engineers.

3. As an incident to this development sufficient hydro-electric power can be generated at the dam to repay the government all money advanced in the construction of the project, together with interest, well within a period of 50 years. Secretary Work in his report on the project estimates that the repayment can be made in 25 years.

4. Under the provisions of the pending bill, before a dollar of federal money can be appropriated or expended the local interests to be benefited must put up with the Secretary of the Interior valid and binding contracts, agreeing to take water and power at the rates to be fixed by the Secretary, which in the aggregate will guarantee the return to the United States government of the entire cost of the project, estimated by government engineers at $104,000,000, together with 4 per cent interest. Through the taxing powers possessed by the interested municipalities, irrigation and water districts, more than $4,000,000,000 worth of property will be placed back of these contracts.

5. An unfortunate international complication exists, due to the fact that the entire water supply for 65,000 American citizens in the Imperial Valley, after being diverted from the Colorado River in the United States, flows for approximately 60 miles through Mexico, where the water is subject to diversion and use. It is necessary for the protection of American water rights in all the basin states against the initiation of new rights by water users in Mexico, by an enlarged beneficial use there, that the All-American Canal be authorized to take the place of the present canal.

6. The magnitude of the project, the fact that the Colorado River is an international as well as interstate navigable stream, the urgent necessity for flood-control works beyond the means of local communities to build, the necessity for an impartial agency to make an equitable distribution of the benefits of the project to meet the legitimate demands of the interested states for water and power, all make the federal government the logical agency to construct this project.

7. The Swing-Johnson bill now pending before Congress embodies the matured plan of the government engineers.

Tennessee Valley Report

In connection with the exhaustive survey being made of the Tennessee Valley the Chief of Engineers has submitted to Congress the final report on the Tennessee, Clinch and Powell Rivers and a progress report on the remaining portions of the study. The cost of the Cove Creek dam is estimated at $37,540,000. If it is built, it should be tied in with the Clinton, Melton Hill, and Kingston dams, the report says, which will cost an additional $24,900,000. When property damages are added, the entire project would cost $86,016,000. To develop the maximum power resources of the river, the report continues, nine dams should be built between Knoxville and Colbert Shoals. Dam No. 3 at Muscle Shoals being one. All this would cost a billion dollars.

Conowingo Goes on Lines

Power from Two of the Seven Hydro-Electric Generating Units Which Will Form the Initial Installation Is Transmitted to Philadelphia

ONE minute after midnight on Thursday morning, March 1, power was transmitted to Philadelphia from Conowingo over the 65 miles of wire that already connect the great hydro-electric plant on the Susquehanna River, just across the Maryland boundary, with the system of the Philadelphia Electric Company. The energy thus received was put to use to supply its fraction of the demand. At 12:10 a.m. the recorder showed that 30,000 kw. was coming into Philadelphia from Conowingo. Simultaneously there was a sharp dropping off in the production of two of the company's main steam stations, the Delaware, in northeastern Philadelphia, and Chester station, at Chester, Pa. Operations of the generators at these plants were gradually reduced as the Conowingo turbines came into service.

There was no formal ceremony. Roger Taylor, superintendent of the Conowingo plant, directed the operation, and the flowing of the energy into the Philadelphia system was recorded in the load dispatcher's office at the headquarters of the Philadelphia Electric Company, at Tenth and Chestnut Streets. William H. Taylor, president of the Philadelphia Electric Company, issued a statement, in part as follows:

"The great Conowingo hydro-electric project of the Philadelphia Electric Company is virtually completed, three months ahead of schedule. Thus is inaugurated an engineering project of major importance in the electrical industry, a project that was completed in record time—a hydro-electric project which is the second in importance in the United States and one which will be of the greatest value to the Philadelphia district."

Work on the Conowingo plant was started March 8, 1926. It is expected that its initial installation of seven 54,000-hp. waterwheels will provide about 1,150,000 kw.-hr. of electricity annually from water power. When the transmission system is completed the power will be sent to Philadelphia over two 220,000-volt, three-phase lines. The total cost of the project will be around $52,000,000.

Stone & Webster constructed the plant at Conowingo, subletting part of the work to the Arundel Corporation of Baltimore. The hydraulic machinery now in place was manufactured by the Allis-Chalmers Manufacturing Company (see ELECTRICAL WORLD for March 3, page 475) and the generating units by the General Electric Company. These two firms will each furnish four of the generators and the waterwheels respectively, and three are to be supplied by the Westinghouse Electric & Manufacturing Company and the I. P. Morris Company respectively.

Full-page advertisements announcing the operation of the plant were printed in Philadelphia and New York newspapers by the Philadelphia Electric Company, the General Electric Company and Stone & Webster.

Excitement Over Radio Legislation at Washington

Geographic equalization of radio zones without regard to great centers of population, the principle embodied in the Watson amendment to the 1927 law, has aroused great opposition in territories threatened with the loss of much of their "air" power, and prophecies are made that passage of such a bill will kill the broadcasting industry. The Radio Corporation of America, the American Telephone & Telegraph Company, Commissioner O. H. Caldwell of the Eastern district and others have come in for attacks from Senator Dill of Washington, Representative Davis of Tennessee and other congressional critics. The House was to consider legislation on Thursday. Last year's provisions expire on March 15, and unless new legislation is enacted or the term of the commissioners, two of whom have not yet been confirmed, is extended, chaos will return.

Cleveland Electric to Have 59 More Miles of 132-Kv. Line

Announcement comes from the Cleveland Electric Illuminating Company that it will on April 1 begin the construction of a 132-kv. steel-tower transmission line, 59 miles in length, to supply additional electric power in northeastern Ohio. Within the past two years the company has rehabilitated various properties acquired in Lake, Geauga and Ashtabula Counties and has made many improvements and extensions, including 125 miles of 33-kv. lines connecting with Lake Shore and Avon stations. It recently began construction of a second 28-mile 132-kv. line connecting Avon station with the Clinton Road substation, which distributes power to the westerly portion of the Greater Cleveland area. This line will be finished about Aug. 1, at the same time that a new unit will go into operation at Avon station increasing the company's total generating capacity to more than 400,000 kw.

The new northeastern Ohio line will connect with the present 132-kv. system south of Cleveland and will follow a route across Lake County to a substation to be erected in Saybrook Township. There it will be connected with the present 33-kv. system. The line will consist of approximately 450 steel towers, supporting six copper wires strung in spans averaging 700 ft. The right-of-way will be about 100 ft. wide. With its completion the company will have 137 miles of 132-kv. transmission.

The new transmission project brings the company's 1928 budget for improvements and extensions up to $11,600,000. The new line will take several months to complete and will call for an investment of approximately $1,800,000.

Truck Users Relate Experiences at Conference

An unusually good program was carried out at an electric truck conference in New York City, March 6, 7 and 8, held under the auspices of National Electric Light Association committees and in conjunction with the eighth annual electric truck exhibit in the New York Edison-United Companies building. Talks by users of electric truck fleets were the feature of the conference. The speakers were Matthew J. Gory, United Dressed Beef Company; George Ford, American Railway Express Company; F. P. McDaniels, Western Electric Company; Joseph Husson, Electo Company (Lord & Taylor and McCreery & Company, department stores); Charles S. Morris, Metropolitan Fireproof Warehouse Corporation; H. A. Currie, New York Central Railroad; Charles F. Wark, Pilgrim Steam Laundry, and Henry Fallerius, Bloomingdale Brothers (department store).

Utility representatives from New York, Newark, Boston, Cleveland, Chicago, Indianapolis and Pittsburgh outlined their electric truck sales programs. J. C. Boyers, Ward Motor Vehicle Company, and C. B. Cook, Industrial Truck Manufacturing Company, presented addresses from the manufacturer's angle. At a session of the truck-operating committee of the Metropolitan Section, N.E.L.A., reports of experience in the maintenance and servicing of trucks in New York, Baltimore, Chicago, Detroit and New Jersey were presented.

New York Assembly Rejects Smith's Power Bills

The New York State Assembly last Monday, after a sharp debate, rejected, by a vote of 85 to 60 motions to bring both Governor Smith's water-power measures out of committee. One of the Governor's measures would create a state Power Authority to bring to the next Legislature a comprehensive plan for the development by the state of its hydro-electric resources. The other bill would submit the question of power development to the voters of the state this fall through a referendum. The Republican leaders now are planning to rush through their own water-power proposal, providing for a commission to investigate and report back to the 1929 Legislature. Governor Smith intends to veto the measure.

"Inverted Speech" by Telephone Demonstrated

Before the New York Electrical Society on Wednesday evening of this week, Sergius P. Grace, general commercial engineer of the Bell Telephone Laboratories, demonstrated a process for "inverting" or "scrambling" words or sentences spoken over the telephone so that they are incomprehensible to any "listener in" and then reconverting them

to their ordinary sound for the intended recipient. This is accomplished by the manipulation of sound frequencies at the transmitting end and their retranslation at the receiving end. Mr. Grace worked the device also in the reverse way, enunciating meaningless or imaginary words which the loud speaker used gave forth as proper ones. Possibilities of a commercial use for this process, where secrecy is desired, suggest themselves, but these have apparently not yet been worked out. Any intention to apply the method, which can, of course, be used with music as well as words, to radio transmission to enforce the purchase of patent "unscramblers" is emphatically denied by telephone officials.

Quebec Authorizes Beauharnois Power Project

The private bills committee of the Quebec Legislature has placed the seal of approval on a bill whereby the Beauharnois Light, Heat & Power Company is authorized to build a power canal between Lake St. Francis and Lake St. Louis, developing 500,000 hp., half of which may be exported to the Province of Ontario on conditions fixed by the provincial government. A feature of the vote on the bill was that all the ministers of the government voted for it, a fact which in itself meant the success of the measure, though it was not a government bill. Premier Taschereau had previously pronounced himself in favor of the project as being one for the general benefit of the province, and particularly beneficial to the district of Montreal, which would have 500,000 hp. developed at its very doors. The federal government must also give its sanction. Doubt exists whether this sanction will be given until the courts decide the question of federal and provincial jurisdiction of water powers developed on navigable waterways.

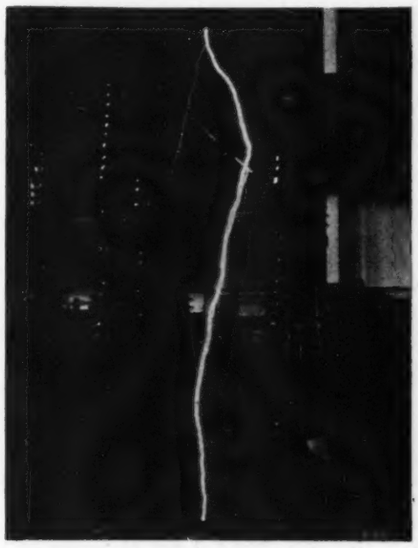
When the engineers who investigated the St. Lawrence scheme submitted their report, they favored a route on the north side for the waterway in the district in question, although also commending the southern route where the proposed Beauharnois canal is to be located. With the interests behind this concern the names of prominent financiers like Frank P. Jones and E. R. Wood are associated. They are understood to have offered to build the canal and present it free for navigation as part of the St. Lawrence waterway if they receive compensation in the form of the power rights incidentally developed. Opponents of the bill contend that it means drying up the St. Lawrence River between Lake St. Francis and Lake St. Louis and thereby putting an end to existing power plants on the St. Lawrence, including those of the Canadian Light, Heat & Power Company and the Cedars Rapids development of the Montreal Light, Heat & Power Company. The first-named company has a development of 30,000 hp. at St. Timothée, having used the old Beauharnois canal under lease.

Voltage Up to 3,600,000

New Record Set in the Production of Artificial Lightning at Pittsfield Is Reported by F. W. Peek at St. Louis Regional Meeting of A.I.E.E.

ARTIFICIAL lightning of 3,600,000 volts, the highest ever obtained and about seventeen times greater than that of any transmission line in this country, has been produced in the high-voltage engineering laboratory of the General Electric Company at Pittsfield, Mass. F. W. Peek, Jr., in charge of this work, announced the achievement March 7 in speaking before the regional convention of the American Institute of Electrical Engineers in St. Louis. The new generator is unique in operation. The electricity is gradually stored in artificial clouds just as electricity is stored in real thunder clouds, Mr. Peek said, and is then discharged in a blinding flash.

"Lightning sparks produced by these



A 3,600,000-volt artificial flash

voltages, lasting but one ten-millionth of a second, can be seen as a blinding flash. However, as light travels about 100 ft. in that time, the phenomenon is all over when a person standing but 100 ft. away sees it or when the light reach him, Mr. Peek explained.

The Pittsfield laboratory has pioneered in the development of power transmission and high voltages since it supervised the construction of the first 15,000-volt line in 1891. Seven years ago this laboratory was first to announce 1,000,000 volts, four years later 2,000,000 volts was announced, and now come voltages almost twice as great. Although these voltages frequently have a duration of less than a millionth of a second, their rate of rise and fall or wave shape has been accurately measured by the cathode-ray oscillograph developed by the general engineering laboratory of the General Electric Company at Schenectady.

"The object of the study is to secure scientific information on the nature of electricity and to obtain further engineering information on the protection of life and property against lightning, to build transmission lines, transformers and other electrical apparatus to resist lightning voltages," Mr. Peek said.

From direct voltages of 3,000,000 voltages of more than 5,000,000 of very short duration were observed by reflection from the open end of a line in the experiments, Mr. Peek said. Mr. Peek and his associates have been experimenting with these voltages for many months, and he laid emphasis on the fact that his success was in a large measure due to the assistance of his associates.

A report of the St. Louis meeting of the Institute will be printed in next week's ELECTRICAL WORLD.

Seattle Lighting Department Records Progress

In its report for 1927, just available, the Seattle Lighting Department chronicles the beginning of the work on Diablo Dam designed to give the Gorge plant a dependable peak capacity of 40,000 kw., says that machinery for Cedar Falls unit No. 6 has been ordered and may be in operation for next winter's peak, and urges the immediate construction of a second Skagit transmission line at a cost of $2,218,000 and the immediate installation of a third unit at the Gorge, to develop 25,000 hp. and operate in 1928, and of the first two 40,000-hp. units of the Diablo plant, to operate in 1929. This 105,000 additional horsepower is to cost $3,620,000—$600,000 for the Gorge and $3,020,000 for Diablo—or only $34.48 per horsepower. Later on another 40,000 hp. at Diablo is to cost $760,000. The report condemns the proposed Hanging Rock dam as uneconomical—"a financial and engineering blunder."

The report, after recording a substantial gain in earnings and output, makes the following reply to the argument for taxation of municipal plants:

The average rate throughout the country for electric current for lighting during 1927 was 6.6 cents per kilowatt-hour as against 2.73 cents per kilowatt-hour for city light. The electric company sells approximately $3,400,000 worth of current in Seattle per year and the city $4,300,000 worth, making a total in the neighborhood of $7,700,000 per year in Seattle and vicinity. If this current were sold at the average rate prevailing throughout the country, it would cost the consumer $17,000,000, which indicates a saving from municipal competition of $9,300,000 per year. When we consider that the total amount of taxes for the city of Seattle for 1927 was $8,500,000, the argument that the city is losing a great deal of revenue because city light is not taxed entirely loses its force. As a matter of fact, the tax paid by our competitor for the year 1926 amounted to only 0.82 mill per kilowatt-hour of current sold.

The City Council has passed a bill appropriating $625,000 for the third unit and other equipment of the power plant and system at Gorge Creek. It is designed for completion in the winter of 1928-29.

Political Echoes Resound in Public Utility Field

Charles M. Hay of St. Louis, a Democratic candidate for United States Senator from Missouri, in opening his campaign condemned public utility holding corporations that apparently are outside the regulation of the state public service commissions, indorsing the investigation proposed by United States Senator Walsh of Montana. Mr. Hay advocated rigid regulation of the sale of securities of such holding corporations and declared that Congress should conduct an honest and thorough investigation into the operations of the holding companies and then act promptly if remedial action can be taken.

Attorney-General O. S. Spillman of Nebraska is a candidate for the Republican nomination for United States Senator, contesting with Senator R. B. Howell, who won the place six years ago with a record as a municipal ownership man. In his statement to voters asking for support, Mr. Spillman makes much of what he terms his successful effort to curb "the power trust" by the injunction secured in Cedar County restraining the Interstate Power Company from cutting rates below cost to destroy a plant erected by the Hord company under a contract to sell the same to the city. He claims that it was an important victory because it established that in law electrical energy is a commodity, thus making it possible to prevent discrimination in prices as between communities.

Olin R. Holt, an attorney of Kokomo, Ind., has announced he will seek the Democratic nomination for Governor of Indiana on a platform pledging himself if elected to work for the abolition of the Indiana Public Service Commission. The law creating the Indiana commission was passed at the 1913 session of the Legislature.

Ex-Senator Frederick W. Hinckley, South Portland, Me., who is a candidate for the Republican nomination for Governor, is sponsor for a plan to bring electric light service to more rural sections of Maine. He declares: "I believe the time has come for the State of Maine to give financial aid toward the construction of transmission lines into these localities, and at the next Legislature this matter should have most serious consideration, with a view of putting it into practical effect. I know of no greater service the Legislature can render than this."

Power Commission Interested in Herminghaus Decision

The Federal Power Commission has asked the Railroad Commission of California to defer its decision on the application of the East Side Canal & Irrigation Company for approval of the transfer of riparian lands and rights owned by that company on the San Joaquin River to the Southern California Edison Company. The Federal Power Commission's plea is based on the fact that the East Side company case is the outcome of the California Supreme Court's decision in the suit brought by the Herminghaus estate against the Southern California Edison over the matter of riparian rights in connection with the California Edison company's development of water power. The Federal Power Commission says that the United States, not having been a party to the suit, did not have its rights adjudicated and is not bound by the decision and that the Attorney-General is now considering a suit to establish the rights of the United States.

"Electrical World's" London Letter

Electrical Service in England Under Flood Conditions—Submarine Cables Versus "Beam" Radio—Electrical Contractors as Retailers—Rural Supply of Energy

By Bernard C. Holding
Editor of *The Electrician*

London, March 1, 1928.

When the Mississippi River so disastrously stepped out of its course a year ago very few people in this country could visualize what appalling disaster such an event can create. In January Londoners experienced for themselves, though on a very much smaller scale, its baneful effect. In that month the overflowing Thames burst through an embankment into a congested city area and within a few minutes drowned numbers of sleeping residents. The inundation took place in the night, but although a number of the power stations in the affected area were partly flooded, there was no single case of a failure to supply electricity, though one badly affected station had to requisition a supply from an interconnected plant. In many cases a supply was maintained only by the unremitting efforts of the power-station staffs, and in one instance an assistant charge engineer, at great risk to himself, remained waist-deep in water for five hours regulating the steam-driven rotary boiler-feed pumps, as the governor by which they were normally regulated had been put out of action by the flood. Although the damage done to the generating stations was comparatively slight, damage to substations, feeder pillars and other parts of the systems was considerable. A good deal of damage was done to consumers' installations, and one plant in an industrial area reported a drop of 100,000 kw.-hr. in its weekly demand.

The submarine-cable communication companies, which have long professed indifference to the growing competition of the "beam" radio system, have suddenly changed their views, and the government has been asked whether it will take steps to bring about cooperation between the two methods of communication. The chief obstacle in the way of the realization of such a proposal lies in the fact that it would be very difficult to formulate a scheme which would give the cable companies what they want without entailing considerable sacrifices on the part of the wireless interests. Meanwhile two eminent chartered accountants, one representing the cable companies and the other Marconi's Wireless Telegraph Company, are preparing a joint report on the whole situation. Pending the issue of this report, it would be unwise to anticipate any closer relation between the rivals.

The electrical contractors, who have not as a class shown particular interest in the retailing of electrical goods through a shop, are now beginning to pay attention to this side of the business. Many of them hold that an electric shop, unless supported by a flourishing installation business, is not a paying proposition, in view of the present state of domestic electrification in this country. Be this as it may, many hardware men, druggists, garage keepers, musical-instrument dealers and other retail traders have been quick to see the possibilities for the extensive sale of domestic electrical appliances and are planning to develop this trade. As an instance of the extent to which retailing has got away from the electrical trade, it has been stated by the sales manager of a company selling electric tools that only 2 per cent of his total sales of these appliances goes through the electrical trade. Realizing the coming competition, the electrical contractors are now actively discussing the potentialities of electrical shopkeeping.

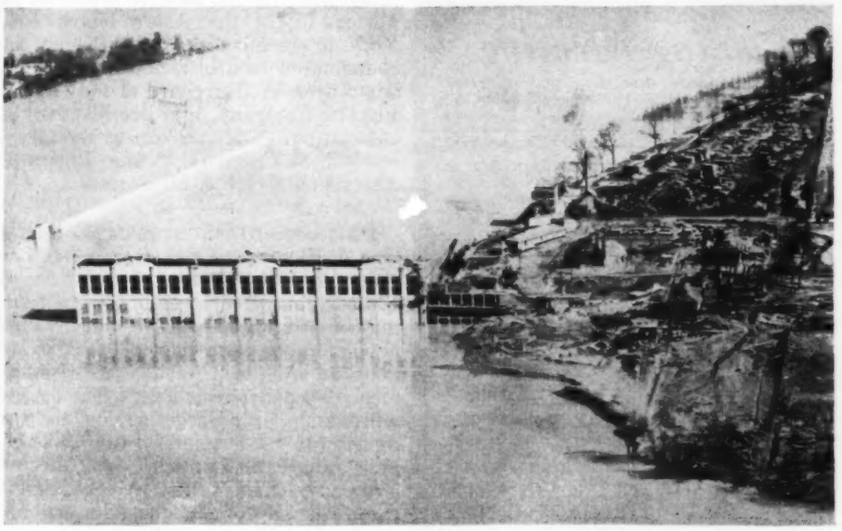
The doubts that have long been expressed as to the ability of the national electricity scheme to give supplies to the "truly rural" areas, which now depend on oil and other primitive methods of illumination, were strengthened by a recent statement by the Minister of Transport, in which he said that after long and careful consideration he had evolved a plan for submission to the government whereby in certain rural areas electricity would be available for all who wanted it. Those who remember the promises—made while the new electricity act was before Parliament—that the scheme would "save British agriculture" are beginning to wonder whether they heard aright!

On the personal side, January saw the bestowal of a knighthood upon J. R. Brooke, the secretary of the Central Electricity Board, while W. T. Leech, director of telegraphs and telephones at the General Post Office, has been made a C.B. (civil division). As you have very likely already noted, the seventh

award of the Faraday medal has been made to Prof. J. A. Fleming, F.R.S. Death has removed several important members of the electrical community. Among those whose loss will be widely felt are Leon Gaster, the founder of the Illuminating Engineering Society; Charles Vernier, probably the most prominent of our mains engineers, who was responsible for the laying down in County Durham of the first large 20,000-volt cable system in the world; Charles Day, a well-known lift engineer and a director of Waygood-Otis, Ltd., and James A. Harris, who at one time occupied important positions with the Westinghouse Electric & Manufacturing Company, Pittsburgh, and at the British Westinghouse Company's Manchester works.

Louisville's 100,000-Kw. Automatic Hydro Station

WHAT the manufacturer calls by far the largest automatically controlled hydro-electric station in the world will soon be in regular operation on the Ohio River at Shipping Port, just below Louisville. This station was recently completed for the Louisville Hydro-Electric Company and will generate 100,000 kw. In design, construction and operation it represents a complete departure from conventional practice. The present installation consists of eight 12,550-kva. vertical-shaft generators operating on a terminal voltage of 14,000. Space is provided on the dam for two more generators in the future, which will bring the ultimate capacity of the station up to 125,500 kva. All generating and control equipment was manufactured by the General Electric Company.



Shipping Port automatic station has unusual features

The principal unique feature of the station resides in the electrical layout. The conventional switchboard has been entirely eliminated and has been replaced by individual control panels installed in cabinets or "cubicles" alongside of each generator. Each cubicle contains relay mechanisms for starting, running and stopping its generator, together with protective equipment for emergency conditions. A synchronism and voltage checking device makes it possible to connect a generator to its bus until electrical conditions are correct. In normal service the station is under the management of a supervisor centrally placed at his controlling cabinet. When the load demand increases the supervisor indicates by means of a signal light on a generator cubicle that this machine is needed on the line. The floor attendant immediately operates the starting button on this cubicle, and the gate-operating mechanism is put in motion, bringing the generator up to speed. As soon as the machine is in rotation the automatic control devices come into play and the incoming machine is placed on the bus as soon as its electrical conditions are correct.

The extremely erratic behavior of the Ohio river produces a head of water on the station varying from zero to 37 ft. The high-water low-head season lasts about three months of the year, and during this time the station will be shut down. When the effective head has reached 9 ft. it is possible to carry a light load on the generators, and this load is increased until a maximum head of 37 ft. permits the station to generate its full capacity. A peculiarity of the station is that there are no windows within 25 ft. of the generating room floor, as the station is virtually half under water during the flood season.

The dam and building, of which a bird's-eye view is shown above, were designed and constructed by the Byllesby Engineering & Management Corporation. The power generated is sold to the Louisville Electric Light Company, after transmission at 66,000 volts over two miles of line to the steam station of the company in the city of Louisville.

Purchases and Mergers

Stone & Webster Announce Another Group Organization of Large New England Companies — New Holding Company Has Plants in Five States

STONE & WEBSTER have announced the formation of a voluntary Massachusetts association to be known as the Eastern Utilities Associates for the merging of New England public utilities which have gross earnings of $8,500,000. The companies immediately involved are the Blackstone Valley Gas & Electric Company, the Edison Electric Illuminating Company of Brockton and the Electric Light & Power Company of Abington and Rockland. They are already physically connected.

A new holding company to be known as the Atlantic Public Service Corporation will, besides water and ice concerns, take over six companies giving electric service and formerly controlled by the Atlantic Public Utilities, Inc. They comprise the Caribou (Me.) Water, Light & Power Company; the Shenandoah River Power Company of Meyer's Falls, Va.; the Potomac Valley Power Corporation of Petersburg, W. Va.; the Indiana Light & Power Company of Defiance, Ohio; the Ohio Northern Public Service Company of Bowling Green, Ohio, and the Provincetown (Mass.) Light & Power Company.

All necessary preliminaries having been complied with, the Delaware Electric Power Company (formerly the Wilmington & Philadelphia Traction Company) became a part of the United Gas Improvement Company system on the first of the month, in accordance with announcement.

The Dowagiac (Mich.) Light & Power Company has been taken over by the Middle West Utilities Company. The properties, consisting of the electric and gas distribution systems serving the city of Dowagiac and the village of Cassopolis, will be operated by the Michigan Gas & Electric Company.

The Central Power Company has purchased the distribution system from the municipality of Brock, Neb. The Village Board of Palmer, Neb., has agreed to sell its municipal distribution system and electric light plant to the Central Power Company, provided the voters approve in April.

The Wisconsin Power & Light Company has purchased a number of small electric lines in the vicinity of Prairie du Sac. These purchases embrace the Sauk-Prairie Light & Power Company, Sauk County Utilities Company and part of the lines of the Prairie Electric Company.

The Missouri Public Service Commission has authorized the Central States Edison Company of Delaware to purchase the common stock of the Gasconade Power Company, operating in Gasconade, St. Aubert, Bonnet's Mill, Osage City and other towns in east central Missouri. The company will pay $186,200 for the stock, which has a book value of $173,779.

Ownership of the electric light plants of Mansfield, Ava, Seymour, Norwood and Mountain Grove, Mo., has been transferred to the Interstate Power & Light Corporation of Chicago, which has purchased the systems from the Central States Power & Light Corporation of Davenport, Iowa.

The Indiana Public Service Commission has approved the purchase by the Interstate

Public Service Company of the Midway Electric Company of Shipshewana for $20,000.

The Suburban Power Company has been authorized by the Ohio Public Utilities Commission to sell its property in Erie, Sandusky, Wood and Lake Counties to the Erie Power & Light Company for $75,000.

Three Iowa towns sold their electric distribution systems in February—Jolley to the Iowa Public Service Company, Waukee to the Iowa Power & Light Company, and Halbur to the Iowa Public Service Company.

Stafford, Kan., has lost its fight before the Kansas Public Service Commission to prevent the sale to a private company of the municipal distribution system of Sylvia, an adjacent town which has been served for a number of years from Stafford's municipal power plant.

The M. B. Light & Power Company, operating in Morrisville, N. Y., and near by, has made application to the Public Service Commission for authority to transfer its franchises and system to the New York State Electric Corporation.

Eight million dollars is announced as the price paid by the Oklahoma Power & Light Company for the Charles Page utilities at Sand Springs (ELECTRICAL WORLD, Feb. 25, page 423).

Missouri Has 600,000 Hp. in Undeveloped Water Power

A survey of the undeveloped water resources of Missouri completed in 1927 by H. A. Buehler, State Geologist, showed approximately 600,000 hp. susceptible of profitable commercial development. Virtually all of the sites included in the list are now under permit, various corporations and individuals having obtained rights from the Federal Power Commission, and many of these permits are now being offered to public utility companies. The chief sites listed in the Buehler survey are:

White and James Rivers in Barry, Stone and Taney Counties, 220,000 hp.; under permit to the Empire District Electric Company of Joplin.

Black River, near Piedmont, in Reynolds and Wayne Counties, 30,000 hp.; under permit to W. H. Meridith of Poplar Bluff. The Black River Hydro-Electric Company took bids on construction of this project on June 24, 1927, but no further action has been taken, pending financing and arranging contracts for sale of energy.

Current River, in Carter, Ripley and Shannon Counties, 100,000 hp.; permit held by the Missouri Hydro-Electric Company of Kansas City.

Osage River, 6 miles above Bagnell, in Miller County, 100,000 hp.; permit held by the Missouri Hydro-Electric Company under option to Stone & Webster of Boston; Union Electric Light & Power Company of St. Louis considering taking over this project.

Gasconade River, in Pulaski and Phelps Counties, 100,000 hp.; permit held by the Central Missouri Power & Water Company.

The White River Power Company, through Hugh L. Cooper and the North American Company, has applied for a federal permit for the use of White River in Taney County, while the Gasconade River Power Company has applied for a permit to use Gasconade River in Osage, Maries and Phelps Counties.

Briefer News

TEXAS CITY PLANT WILL GENERATE 6,000 KW.—Construction of the Texas City electric power plant announced by the Texas Gulf Power Company will be started soon, according to P. J. Hayes of Galveston, district manager. The plant will cost approximately $350,000 and will have a capacity of 6,000 kw. From it there will be constructed a system of wooden-pole transmission lines to towns of the Gulf Coast section.

NORTH CAROLINA TOWN TO BUILD HYDRO PLANT IN AGREEMENT WITH MILL COMPANY.—The town of Marshall, N. C., and the Marshall Mill & Power Company have entered into a contract whereby, on the approval of the voters, the town is to take over the company's water-power site on the French Broad River and rebuild and enlarge the mill plant. The mill will purchase power at $5,000 a year. The new plant will be rated at about 1,800 hp. and will, it is estimated, cost $175,000 besides $90,000 for the site.

EUROPEAN TOUR FOR ENGINEERS.—Engineers associated in the Midwest Power Conference are planning to go abroad on an "international power tour," sailing from New York on Aug. 18. While in Europe they will visit large power plants and new developments in various countries. The tour will last six weeks and there will be time for sightseeing and scenery. Headquarters for the tour have been established at Suite 656, 25 Broadway, New York.

A. W. BURCHARD'S AID TO ARBITRATION TO BE THEME OF MEMORIAL LUNCHEON.—The American Arbitration Association is to hold a luncheon on March 15, at the Astor Hotel, New York, to signalize its appreciation of the contribution to arbitration made by the late Anson W. Burchard of the General Electric Company, first president of the association. The speakers at the luncheon will be Owen D. Young, Lucius R. Eastman and Julius H. Barnes.

PHILADELPHIA-SUBURBAN COUNTIES GAS & ELECTRIC CUTS RATES.—A rate reduction to consumers of electricity in Philadelphia suburbs embracing a territory of about 1,400 square miles, with a population of more than 600,000, is announced by the United Gas Improvement Company, which says that the cut will result in a large saving to customers of its subsidiary the Philadelphia-Suburban Counties Gas & Electric Company. Under the new schedule the rate will be 10 cents a kilowatt-hour for the first 50 hours instead of 11 cents.

ABOUT $2,500,000 ASKED FROM LEGISLATURE FOR ONTARIO HYDRO THIS YEAR.—Hydro requirements bulk large in the Ontario government estimates for the year 1928, which were tabled in the Legislature on March 1. The total requisition for hydro purposes is $2,470,000. Of this, $400,000 is for transmission and distribution lines and rural distribution in connection with the Niagara system. The largest single item is for the St. Lawrence and Ottawa Hydro system, $1,250,000 being set aside for transmission lines and $350,000 for transformer stations on this system.

MODESTO-DON PEDRO TRANSMISSION LINE READY IN SPRING.—Construction work on the Modesto Irrigation District's direct transmission line from Modesto to Don Pedro, under way for ninety days against adverse conditions, is progressing rapidly, and completion in the spring is assured, according to B. W. Creim, chief electrical engineer of the district. This line, on the north side of the Tuolumne River, is to be 40 miles in length. It will insure the district against interruption in service, according to Mr. Creim, who further

Coming Meetings

[A complete directory of electrical associations, with their secretaries, is published in the first issue of every volume. For latest list see ELECTRICAL WORLD for Jan. 7, page 80.]

Northwest Electric Light and Power Association — Accounting Section, Portland, Ore., March 12. Berkeley Snow, 1208 Spaulding Building, Portland, Ore.

Oklahoma Utilities Association—Mayo Hotel, Tulsa, March 13-15. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

Illinois State Electric Association—Hotel Abraham Lincoln, March 14-15. R. V. Prather, 205 Illinois Mine Workers' Bldg., Springfield, Ill.

National Electrical Manufacturers' Association—Policies Division, Edgewater Beach Hotel, Chicago, March 14-16. S. N. Clarkson, 420 Lexington Ave., New York.

Maryland Utilities Association—Emerson Hotel, Baltimore, March 23. G. S. Williams, 1005 Continental Bldg., Baltimore.

Southwestern Division, N. E. L. A.—Edgewater Gulf Hotel, Biloxi, Miss., April 3-5. S. J. Ballinger, San Antonio Public Service Company, San Antonio, Tex.

Nebraska Section, N. E. L. A.—Omaha, April 4 and 5. T. E. Browne, 1527 Sharpe Bldg., Lincoln.

Southeastern Division, N. E. L. A.—Miami, Fla., April 11-14. C. M. Kilian, 207 Bona Allen Bldg., Atlanta.

American Institute of Electrical Engineers — Baltimore regional meeting, April 17-19; New Haven regional meeting, May 9-11. F. L. Hutchinson, 33 West 39th St., New York.

American Welding Society—Engineering Societies Building, New York, April 25-27. M. M. Kelly, 29 West 39th St., New York.

American Electrochemical Society—Bridgeport, Conn., April 26-28. C. G. Fink, Columbia University, New York.

Missouri Association of Public Utilities—Jefferson City, April 26-28. F. D. Beardslee, 315 North Twelfth St., St. Louis.

Southwestern Public Service Association—Dallas, Tex., May 2-5. E. N. Willis, 403 Slaughter Bldg., Dallas.

Middle West Division, N. E. L. A.—Hotel Statler, St. Louis, May 9-11. T. A. Browne, 1519 O St., Lincoln, Neb.

American Society of Mechanical Engineers—Pittsburgh, May 14-17. Calvin W. Rice, 29 West 39th St., New York.

National Electric Light Association—Atlantic City, June 4-8. P. S. Clapp, 420 Lexington Ave., New York.

believes that it will pay for itself in from five to six years through reduced cost of transmission, even though the rate of consumption does not increase.

MISSOURI COMMISSION TO INQUIRE INTO ST. LOUIS ENERGY RATES.—The Union Electric Light & Power Company of St. Louis having shown in its annual report a net income above all expenses and interest charges of $5,214,479 for 1927, an increase of $927,142 over 1926, certain newspapers are agitating for a decrease in rates, and the Missouri Public Service Commission, with this object in view, has requested the company for additional data. The residential rate is the one where a cut is thought particularly desirable by the commission if it proves feasible.

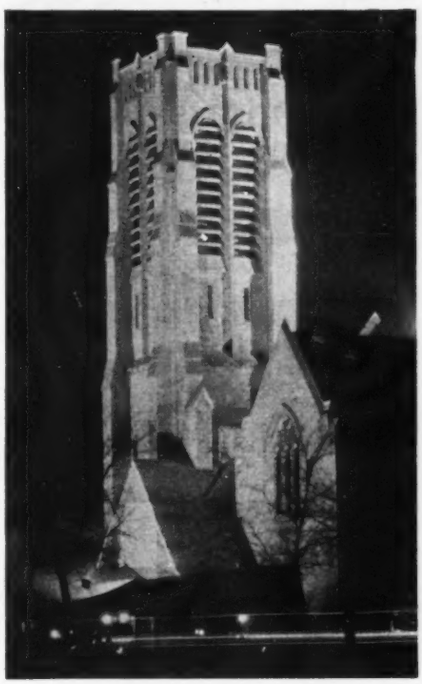
SPECIFICATIONS FOR MACKENZIE RIVER PLANT AT EUGENE, ORE.—Bids have been advertised for a portion of the equipment to compose the first 9,000-hp. unit of the 18,000-hp. Leaburg development of the city of Eugene, Ore., known as hydro-electric power plant No. 2 of that city. The Leaburg development requires a diversion dam on the Mackenzie River, 20 ft. high, with three 100-ft. gates and a 30-ft. sluice-gate. Tie-in with the present system will be effected by 10 miles of 44,000-volt transmission line from Leaburg to plant No. 1 at Waterville.

BIRMINGHAM'S STREET - LIGHTING SYSTEM TO BE TRIPLED IN TWO YEARS.—It is the ambition of James Jones, Jr., president of the City Commission of Birmingham, to make that city the best-lighted in the South. He announces that the city is about to complete two new "white ways," one on Fourth Avenue North and the other in the West End on Tuscaloosa Avenue. The first "white way" includes about 100 new lamps and the second 126. In December, 1926, Birmingham had just 501 street lamps; in December, 1927, it had 927, and it plans to have 1,527 by December, 1928, Mr. Jones states.

PERMITS SOUGHT FOR ARIZONA SITES ON COLORADO RIVER.—Application has been filed with the Federal Power Commission by the Arizona State Board of State Institutions for the development of a hydro-electric project at Grand Wash on the Colorado River. It is stated that 400,000 hp. may be obtained at this point by the construction of a 383-foot gravity dam. The board will also file similar applications for hydro-electric plants at Pearce's Ferry, Flowersack Rapids, Devil's Slide and Bridge Canyon. Applications for hydro-electric plants at these places have also been filed by the Arizona High Line Canal Association.

OSWEGO, N. Y., TO NEGOTIATE FOR FURTHER WATER-POWER RIGHTS ON CANAL.—Oswego, N. Y., wishes to acquire the riparian rights at the east end of Dam No. 6 in the Oswego River so that the city may use the full flow of the river at the dam. Both the Battle Island Power Company and the State of New York claim ownership of these rights, and the city will probably open negotiations with both while awaiting a judicial decision on ownership. The Battle Island company, it is stated, has asked on previous occasions $100,000 for its rights. The municipal power plant at the west end of Dam No. 6, now nearing completion, contains two extra wheel pits for use if the city obtains the rights to the power at the east end.

INDIANAPOLIS CHURCH ADOPTS FLOODLIGHTING AS PERMANENT ATTRACTION.—So pleased were the members of the Broadway Methodist Episcopal Church in Indianapolis with the result attained by floodlighting their new building during the week set aside for dedication exercises that they decided



on a permanent installation which is now in operation. The Robbins Electric Company placed four 1,000-watt floodlamps on the four sides of the tower, and the Indianapolis Power & Light Company supplies the electrical energy.

GOULD STREET, BALTIMORE, WILL SOON RAISE CONSOLIDATED COMPANY'S RATING TO 260,000 KW.—The increase in the Consolidated Gas, Electric Light & Power Company's generating capacity provided by the completion of the first unit of the new Gould Street power station and the rapidly approaching completion of the second unit is noted in the company's annual report, just issued. Completion of the new unit will bring the company's total rating to approximately 260,000 kw., to which is added an available hydro-electric supply from the Pennsylvania Water & Power Company's Holtwood plant amounting to 80,000 kw. With the close of the year a new agreement was made with the Pennsylvania Water & Power Company covering a period of 43 years, making it co-extensive in time with the 50-year contract between the Consolidated and the United Railways & Electric Company of Baltimore for the supply of power to the last named.

MAINE'S 66,000-VOLT LINE NEARLY COMPLETED.—The Central Maine Power Company is finishing its high-voltage transmission line from Gulf Island to Maxcey's, a distributing center. An interesting feature of this line is the crossing over the Kennebec River at Brown's Island. In order to maintain the clearance for shipping required by the United States government it was necessary to erect five steel towers, the two largest of which are 190 ft. high. They provide for jumping the river in two spans of 825 ft. and 95 ft. each. At Gulf Island an addition to the present substation has been built of 15,000 kva. capacity, stepping up the current from 33,000 volts to 66,000 volts, which can be raised later to 110,000.

CONVENTION OF AMERICAN OIL BURNER ASSOCIATION.—Plans for co-operation between oil producers and electric light and power companies in serving the users of oil-heating apparatus will be an important topic at the annual convention of the American Oil Burner Association, to be held at the Hotel Stevens in Chicago on April 3-5. A representative of one of the large electrical companies will speak on the relation of the central station to the oil-heating industry, and the interest of the oil producers in the utilization of oil fuel by owners of homes and commercial buildings will be discussed by an official of one of the large oil companies.

ZILWAUKEE PLANT EXTENSION ON THE SAGINAW THREE-QUARTERS COMPLETED.—Work started by the Consumers Power Company last May at its Zilwaukee steam plant on the Saginaw River, near Saginaw, Mich., is more than three-quarters finished. The extension consisted of a 30,000-kw. Allis-Chalmers turbo-generator, four 1,234-hp. boilers, a 3,500-kw. General Electric house turbine and 45,000 kva. in additional transformer capacity. The original installation at Zilwaukee was 40,000 kw. in two units. In addition, the greater part of the 41,500 kw. generated on the Au Sable River and the 13,000-kw. output of the plants of the Wolverine Power Company on the Tittabawassee feed into the outdoor substation. When the new unit is on the line there will be about 125,000 kw. concentrated at the Saginaw River plant.

RADIO STANDARDIZATION FURTHERED BY THE A. E. S. C.—An effort to stabilize the radio industry through the establishment of national standards of construction and quality of radio apparatus is being made by the American Engineering Standards Committee, which announces the election of Dr. Alfred N. Goldsmith, president of the Institute of Radio Engineers, to the

chairmanship of its committee on radio standardization. The radio committee includes in its membership representatives of the departments of War, Navy and Commerce as well as of the radio industry and interested national associations and groups. Other radio committee members just elected are Dr. Clayton H. Sharp of the Electrical Testing Laboratories, vice-chairman, and C. B. Jolliffe of the United States Bureau of Standards, secretary.

QUEBEC'S REVENUE FROM WATER-POWER RIGHTS.—A report presented to the Legislative Assembly of the Province of Quebec by the Minister of Lands and Forests shows that revenue from water powers in that province is growing large. For the year ended June 30, 1927, it totaled $802,010. The still incomplete development of the Duke-Price Power Company at Ile Maligne has just come into the revenue-paying class, paying the province $9,775. Of the $802,010 mentioned, $468,103 came from the five big dams constructed by the Quebec Streams Commission, which can furnish a flow for many additional developments.

MR. BLACKWELL TALKS ON PREVENTION OF ACCIDENTS.—Plans for the prevention of accidents to workers in the public utility companies of Ohio, West Virginia and Kentucky were discussed at Cincinnati last week as part of an open conference of the accident prevention committee of the East Central Division, N.E.L.A. H. C. Blackwell, president of the Union Gas & Electric Company, Cincinnati, asserted that accidents are nearly always due to carelessness on the part of the men injured and their disregard of the instructions laid down by the management. "We have found that the only remedy for carelessness is either to discharge or to lay off," he said. "All work should be done under predetermined specifications couched in the language of the men who are to obey them." He urged that responsibility in the case of a large utility organization be centered in one man, but that that man have committees of the various departments working under him.

INTERCONNECTION IN MINNESOTA.—Speaking before the annual convention of the Minnesota Federation of Architectural and Engineering Societies, held at Minneapolis Feb. 17 and 18, on "Local Electric Power Stations Versus Interconnection," Oscar Gaarden, sales engineer Northern States Power Company, reported: "As nearly as can be determined, there are in Minnesota today 860 communities receiving central-station electric service. Of these, 746 receive service from interconnected systems and 114 have isolated plants. Of the 860 communities, 230 are served on the retail basis by the largest system, 155 by the second largest, 83 by the third largest, 44 by the fourth largest, 35 by the fifth largest, 114 by small transmission networks and 43 by isolated private plants. Of the 156 communities served by municipal distribution systems in the state, 85 purchase energy from transmission lines and 71 have isolated plants. Of the total number of communities served, 18 per cent are owned by the municipality and 82 per cent by private companies."

OREGON OFFICIALS OPPOSE FURTHER PERMITS FOR HYDRO PLANTS ON INTRASTATE STREAMS.—Oregon's fish and game authorities have announced a definite stand against the further construction of any hydro-electric plant along any state stream or river with exception of locations in the vicinity of headwaters. The fish commission assumed this attitude following a hearing before the State Engineer which involved applications filed by the city of Eugene for authority to establish additional hydro facilities on the Mackenzie River. State Engineer Luper has taken the Mackenzie River dispute under advisement.

Commission Rulings

PUBLIC NOTICE OF CONSOLIDATION IN NEBRASKA A CONDITION PRECEDENT.—The Nebraska Railway Commission, by a two-to-one decision in a telephone merger, has determined that a constitutional provision regarding the giving of public notice covering at least 60 days to stockholders of the contemplated consolidation of competing public utilities is mandatory, not directory, and is a condition precedent to its approval of the consolidation. The minority of the commission held that since that body has no authority to settle disputes between stockholders and no power of management, its duty in the matter of approving consolidations ends when it finds that the proposal is in the public interest. It will assume that the officers of the corporation will obey the constitutional mandate and is without power to make such obedience a condition of approval.

UTILITY MAY BE COMPELLED TO SERVE BELOW COST.—In refusing the Lincoln Telephone & Telegraph Company permission to raise rates at its Endicott exchange to a level where a return on the investment would be insured, the Nebraska Railway Commission held that public utilities may on occasion be required to continue the operation of portions of their property which may be unprofitable, and even though such operation involves a loss, it is not confiscation of property. The commission held that the proposed rates in the case under notice were greater than the service was worth, would result in depriving a number of patrons of telephone service and enable the company to do indirectly what it has not been able to do directly, bring about the abandonment of the exchange. The law requires a 60 per cent petition of patrons for abandonment, and this the company was unable to obtain. The commission maintained that the test of whether the service is worth the rates is what subscribers on adjoining exchanges pay without protest. It pointed out that, while charged with the responsibility of authorizing rates which are not confiscatory to the utility, it must also provide a rate which is fair to the rate-paying public and not in excess of the value of the service.

Recent Court Decisions

RIGHT AND WRONG CHARGES TO JURY ON NEGLIGENCE OF COMPANY.—A judgment for the defendant in Iron City Grain Company vs. City of Birmingham—a suit for damages for destruction of plaintiff's place of business by fire because of alleged negligence by the city in furnishing electricity and maintaining equipment—has been reversed by the Supreme Court of Alabama. This court found erroneous a charge that if the jury could reconcile the evidence with a theory that the defendant was not negligent, it was the jury's duty to do so, and a charge that before the jury could find for the plaintiff it must be satisfied that the facts were inconsistent with the theory that defendant was not negligent was declared confusing and misleading. There was, however, no error in charging that the law did not presume the defendant negligent or that defendant had no duty to maintain wires inside plaintiff's building, there being evidence that the city installed the wires without compensation. A charge that proof which showed only that a thing could have happened in a given way did not warrant the conclusion that it did happen that way was not a reversible error, though it might have been refused. (115 So. 99.)*

"IN THE PUBLIC INTEREST" MEANS "NOT DETRIMENTAL TO THE PUBLIC."—In remanding the case of the Electric Public Utilities Company vs. West to the Maryland Public Service Commission (ELECTRICAL WORLD, Feb. 25, page 422), the Court of Appeals of Maryland defined "the public interest" as conceived by it. The commission, as before chronicled, had refused to permit the Electric Public Utilities Company to purchase from Thomas O'Hara the stock of the Home Electric Light Company of Lonaconing, the Emmitsburg Electric Company, the Antietam Electric Light & Power Company and the Midland Electric Light Company, four Maryland corporations, because it could not "see wherein the public will be benefited in the slightest degree." The Court of Appeals on this point said: "In the case of an owner of the stock of such a company is it within the rule of reason to hold that he may not sell his stock to a corporation unless it can be shown that the public will be benefited by the sale? Or may permission be refused merely because the only consideration moving the parties is one of financial investment which the parties believe to be for their mutual advantage? We think not. If public utilities could be owned only by people whose primary purpose is to benefit the public, few of them would be privately owned. Until human nature changes, enlightened self-interest as the moving cause of enterprise is about the best that can be expected. To prevent injury to the public in the clashing of private interest with the public good in the operation of public utilities is one of the most important functions of public service commissions. It is not their province to insist that the public shall be benefited as a condition to change of ownership, but their duty is to see that no such change shall be made as would work to the public detriment. 'In the public interest,' in such cases, can reasonably mean no more than 'not detrimental to the public.'"

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

News About Men of the Industry

RUFUS E. LEE, formerly president of the Continental Gas & Electric Company and at the present time an investment banker with headquarters in Omaha, has been made head of the Tax Research Association of Nebraska. This association concerns itself with the task of scientific study of taxation with the idea of making recommendations to the Legislature for reforms. Mr. Lee was a pioneer in Nebraska's electrical development.

CARROLL G. BENNETT, formerly chief engineer of the Illinois Commerce Commission, has been appointed chief engineer for the Public Service Company of Northern Illinois. Mr. Bennett's early experience was with the Allis-Chalmers Manufacturing Company and with L. B. Stillwell, consulting engineer, New York. He spent some time with the department of water supply of New York City before removing to Springfield, Ill., in 1921, as assistant chief engineer of the Illinois commission.

WILLIAM W. TRENCH, assistant secretary of the General Electric Company, has been elected secretary of the company to succeed Myron F. Westover, who retired March 1. Mr. Trench has been associated with the General Electric organization since 1915, when he was appointed assistant to Owen D. Young, who at that time was a vice-president. One year later he was named assistant secretary. Mr. Trench is a graduate of St. Lawrence University and the Brooklyn Law School and was admitted to the bar in 1916.

ABEL REYNOLDS has been elected treasurer and general manager of the New England Water, Light & Power Associates, with headquarters in the Hospital Trust Building, Providence, R. I. This organization was recently formed under the presidency of Arthur B. Lisle to operate and control the Central Connecticut Power & Light Company and various water companies in eastern New England. Mr. Reynolds was in the employ of the Narragansett Electric Lighting Company, Providence, for 29 years and was not long since appointed superintendent of the Bristol County Gas & Electric Company, Rhode Island.

MYRON F. WESTOVER, who for almost 40 years has been actively identified with the electrical industry, retired March 1 as secretary of the General Electric Company, the office he had held for 34 years. In 1888 Mr. Westover became secretary to Charles A. Coffin, who at that time was treasurer and manager of the Thomson-Houston Electric Company. Thus began a close friendship and business association which lasted nearly 40 years and was brought to a close by the death of Mr. Coffin less than two years ago. In 1893 Mr. Westover was elected assistant secretary of the General Electric Company, which had been organized only the year before. The following year he was elected secretary, the office he had since that time held.

F. D. Mahoney Now with Electric Bond & Share

F. D. Mahoney, whose resignation as vice-president of the West Penn Power Company was announced in the Feb. 11 issue of the ELECTRICAL WORLD, has assumed his new duties with the Electric Bond & Share Company with headquarters in New York, where he will engage in the expansion of that company's interests in foreign countries. Mr. Mahoney's resignation as vice-president of the West Penn Power Company brought to a close an affiliation which dates back to June, 1922. From that time until 1927 he was commercial manager in charge of the department that developed new business, formed the distribution engineering department, stressed the merchandising of appliances and in other fields made itself an active part of the organization. In 1927 he was named vice-president.

F. D. Mahoney

A graduate of the University of Wisconsin, Mr. Mahoney began his engineering career as lineman's helper, and after serving in various capacities with central stations in the Middle West he joined forces with the electrical engineering department of the American Gas Company at Philadelphia. Here he secured a wide and varied experience in the construction and operation of public utilities. After the war Mr. Mahoney joined the Alabama Power Company as commercial manager, where he remained until his connection with the West Penn system.

J. E. ALDRED, president of the International Power Securities Corporation, and J. A. Walls, vice-president and chief engineer, sailed for Europe March 3, aboard the *Leviathan*. They will visit the properties of the companies in Italy and France in which the International is interested.

T. F. MANVILLE, JR., a director of the Johns-Manville Company, has been elected a director of the Morison Electrical Supply Company, New York.

Obituary

GEORGE MCQUAID, director of public relations for the Central & Southwest Utilities Company, an Insull property, died suddenly March 5 at his home in Dallas, Tex. Mr. McQuade was one of the best-known newspaper men in Texas and Oklahoma, having been identified with various newspapers in those states for 30 years. He was a native of Alexandria, Va., and a lawyer by profession, but soon after opening an office at San Antonio he relinquished his legal practice to enter upon a journalistic career. He served on the staff of such papers as the Kansas City *Journal*, the Guthrie (Okla.) *Capital*, the *Daily Oklahoman*, the Galveston *News*, the Dallas *News*, etc., in capacities that ranged from reporter to managing editor and editor. In 1922 he took charge of the Texas Public Service Information Bureau, which issues weekly news regarding the utilties operating in Texas and about public utilities in general. Subsequently he affiliated himself with the Insull interests.

ALEXANDER SIEMENS, who for many years was associated with the famous engineer and inventor Sir William Siemens and until the World War was the chief representative in Great Britain of the great Siemens electrical interests, died Feb. 16 at Milford-on-Sea, England. The deceased, who was 81 years of age, was a Hanoverian, but became a naturalized British subject in 1878. Settling in England in 1867, he entered the shops of the telegraph factory then recently established by Siemens Brothers at Woolwich, and in the two following years he was engaged in the erection of the Indo-European telegraph line in Persia and in laying cables in the Black Sea. Later he spent seven or eight years in assisting Sir William Siemens with the design and application of the latter's regenerative furnaces. After the death of Sir William, in 1883, he assumed a more important position in the firm of Siemens Brothers, and ultimately he became its chief permanent director resident in England. Alexander Siemens was twice president of the Institution of Electrical Engineers, in 1894 and 1904, and in 1910-11 he was president of the Institution of Civil Engineers.

Financial and Statistical News

Utility Stocks Move Up
Bond Redemptions Heavy

IN THE face of general market weakness power and light stocks have recovered substantially and many have established new high points. American Gas & Electric has touched a new high of 142½ after a run up of twenty points. Public Service of New Jersey common is up four points to 133. Gains are recorded also by Electric Power & Light, Brooklyn Edison, Commonwealth Edison, Pacific Gas & Electric, etc. The average of fifteen representative power and light common stocks is again at 130, which is the high point for all time for this group of stocks.

Bond redemptions continue at a high rate. Nearly $195,000,000 of bonds and notes were called this month for payment in advance of maturity. Although figures are not yet complete, it is understood that utilities are responsible for a large proportion of the total. Obviously, this means a big reduction in interest charges through the substitution of lower coupon obligations and, in some cases, stocks.

Record Monthly and Yearly Energy Output

As has been usual in the past, electrical energy output of public utility plants in January almost equaled that of December, when all records were broken and production for the first time exceeded 7,000,000,000 kw.-hr., according to data collected by the U. S. Geological Survey.

January production was 7,179,000,000 kw.-hr.; for December it was 7,218,000,000 kw.-hr. In each of those months the output was greater than in the entire year 1903. These figures are an indication of the tremendous increase in the use of electricity in recent years.

The average daily output in January was 232,100,000 kw.-hr., a trifle less than the revised figure for December of 232,800,000 kw.-hr., but 6.5 per cent greater than in January, 1927. The total production of electricity by the use of water power amounted to 2,719,952,000 kw.-hr. and closely approached the December figure, the highest ever attained. It constituted 38 per cent of the total in each month.

The total production of electricity in 1927 by public-utility power plants was 79,723,000,000 kw.-hr., an increase of about 8 per cent over the total output for 1926. The accompanying table gives the monthly figures of output for 1926 and 1927, including street railways and other utilities as well as electric light and power companies.

	1926	1927	A	B	C
January	6,159	6,730	9	32	35
February	5,629	6,080	8	34	36
March	6,178	6,717	9	37	38
April	5,812	6,416	10	40	40
May	5,849	6,582	12	40	41
June	5,920	6,475	9	38	39
July	5,955	6,455	8	34	38
August	6,175	6,684	8	34	36
September	6,221	6,607	6	33	33
October	6,594	6,929	5	33	34
November	6,482	6,874	6	35	36
December	6,817	7,218	6	35	38
Total	73,791	79,767	8	35	37

Column A shows percentage of increase in 1927; column B shows percentage of output produced by water power in 1926; column C the percentage so produced in 1927.

NEW YORK CENTRAL ELECTRIC CHANGES SET-UP.—The New York Central Electric Corporation has filed a certificate in the office of the Secretary of State increasing its number of shares from 50,000 preferred stock, $100 par value, and 200,000 common, non-par value, to 100,000 preferred stock, $100 par value, and 200,000 common, non-par.

Associated Gas & Electric to Create $50,000,000 Issue

Stockholders of the Associated Gas & Electric Company at a meeting to be held March 12 will vote on the creation of a fifty-million-dollar issue in the form of 4½ per cent debentures dated March 1, 1928, and maturing March 1, 1948. The company wishes to provide funds for the retirement of certain of its 5½ per cent and 6 per cent convertible debentures, for the acquisition of property and for other corporate purposes. The directors of the company voted on the plan at a meeting held Feb. 16.

Attwill Replies to Critics

Massachusetts Commission Chairman Defends Contract Plan of Regulation—Reproduction Base Assailed

A DEFENSE of the so-called regulation by contract bill (House 170) before the legislative committee on power and light in Massachusetts was recently presented by Chairman Henry C. Attwill of the Department of Public Utilities in rebuttal to arguments against this measure by Sheldon E. Wardwell, representing the Massachusetts Gas and Electric Lighting Association, and by others. The opening argument of Mr. Attwill on behalf of the bill was abstracted in the ELECTRICAL WORLD March 3, 1928, page 479, and the gist of Mr. Wardwell's address is printed on page 509 of this issue. In his rebuttal the chairman of the Massachusetts board maintained that the bill's chief objective is to insure a continuance of past standards of regulation in the Bay State, declaring that the credit of the companies would not be impaired by its acceptance and defending the measure's constitutionality. He spoke in part as follows:

The attitude of the Department on this bill is a sincere desire to advance the interests of the public utilities and the public alike. The suggestion, I think, was made first about 1922 in a report to the Legislature, in relation to the so-called premium law. Since then we have discussed it more fully, and we believe that it is in the interest of the public utilities; that is, those who desire to do real public service to the Commonwealth, and of course it is hostile to those who do not desire to do real public service for the state.

The reproduction theory involves the value of the property by adding absurd factors of cost. We concede that probably in dealing with the situation in the West, the Supreme Court at Washington, after it had once determined that the fixation of rates in any way was a judicial question, found that there was not much of anything that it could have done because no one knew the real investment in the utilities in the West, on account of the tremendous inflation of capital there.

The trouble with the reproduction theory is that it is extremely difficult to operate it, so difficult that it practically negatives regulation. Under that theory of regulation the department cannot hope to treat with more than two or three rate cases in a year, and so it is obvious that the whole power of regulation of rates is paralyzed.

Moreover, these gigantic holding companies and associations, buying up our local companies, owned and controlled by gentlemen living out of the state, who have no interest in Massachusetts traditions or ideals, cannot be expected to do anything but to get every dollar that it is possible for them to get out of the utilities, because they have no interest in Massachusetts other than the amount of money that they can make out of the state. It is to their interest to continue this method of regulation, because they usually furnish the management of the companies and usually have another company that furnishes the management of the local company under contract agreement. Furthermore, in every rate case it appears that they furnish the experts, the accountants, all the paraphernalia, to make the reproduction study and cost, and furnish the witnesses to testify.

Now, we believe this bill is constitutional; if it is not, very likely the present railroad act is not constitutional, because if a state cannot make a contract except a contract which ceases to be good, except so long as the corporation can make a return upon the property, 8 per cent on the reproduction value of the property, it is obvious that the state never can enter into any contract except that it guarantee to pay the other fellow, but the other fellow is never bound to pay it.

I do not believe that can ever be the law in the United States of America. If it is, then it is time that the people of the United States had a constitutional amendment to take care of that situation. Now, the savings institutions of Massachusetts are the wonders of the world. They have attracted capital into them far more readily and far

more quickly than these public utilities have ever attracted capital, and yet back of them is nothing to guarantee the investor except the integrity of the officials of the institution and the examinations by the Commonwealth from time to time to see that their investments are proper. Despite this, in the past century, I doubt if the interest charges in relation to the savings banks of Massachusetts have varied 1½ per cent. There is enough money in the savings banks today on deposit to buy practically every public utility in the state and not disturb a mortgage.

What I would like to do is to so operate the public utilities that I could divorce banking control from the utilities, and I would attract the money of these savings bank depositors readily into these public utilities and give them a better rate of interest than the savings banks do, and equally safe security.

If we can attract money readily into the state treasury on public loans at 4 per cent, with people relying upon the good faith of the Commonwealth of Massachusetts, do you have any misgivings that the public utilities, regulated under Massachusetts traditions and under Massachusetts ideals as they have been for a century, cannot attract capital enough to carry them on at low rates of interest? Why, how absurd!

Our opponents seem to think that our proposition commits the state to guaranteeing a return sufficient to make the stock stay at par. No, it does not do that, but it restrains the state from doing anything which would prevent it earning the dividends which would sustain it at par, and, on the other hand, it in no way commits the state to any hard and fast standard or rule upon which it can earn its dividends and its interest.

Efficiency has not come usually from the stockholders. They are efficient in shouting for dividends, not a doubt about that; but the ones who are entitled to praise for efficiency are usually the operating officials of the utilities, and there are many instances which have come to my attention where the operating officials were efficient in their duties, but were denied adequate compensation by these hungry stockholders.

All this bill does is to seek to insure the regulation of the past, regulation built up on the ideals and traditions of Massachusetts, and not borrowed from the wild and woolly West. And let me say to you that I doubt if there are any utilities in the country whose credit stands better than those in Massachusetts, who heretofore have been content and satisfied to operate under the rules and under the views and under the ideals and traditions that have obtained here in Massachusetts.

The companies have the temerity to come up here and say, if we continue the policy and the system that has pertained in the past we will ruin all the utilities, and that they will not be able to get any cash to finance their undertakings.

It has been my feeling for years that one of the greatest drawbacks to this so-called United States doctrine is that it creates hostile camps between the consumer on the one hand and the stockholder of the corporation on the other hand, where, as a matter of fact, if the corporation is fair, their interests are identical. The consumer gives the surplus; he donates to these gentlemen his streets; he gives them a monopoly. He ought therefore to have in return rates as reasonably cheap as they reasonably can furnish them.

Now, if the corporation is reasonable upon its part, his interest and the stockholders' interest are identical because he needs the service. He knows that there can be no extensions and additions to the capital plant unless he is willing to put the corporation in position to get a fair return upon the stock, which will make the stock attractive as an investment to the investor. Both their interests are conserved. Consequently, when we limit their operations to a fair and reasonable dividend, we assure any additional earnings being held in the treasury and employed in the public service. And by that operation we relieve them from being in hostile camps and we march them side by side, together in that interest of the Commonwealth and the welfare of its people.

I do not believe that we have got to such a stage in Massachusetts that we no longer have public-spirited citizens who are willing to work, and willing to work in the interests of the general public, at fair and generous compensation. This bill in no way contemplates a fixed return. It fixes the minimum return, but it permits the commission to allow any return above that which may be required to protect the financial integrity of the company and allow it to perform its public functions in the interest of the public.

We never will sustain the doctrines, traditions and ideals of men by sitting supinely in a chair and allowing these foreign interests that are coming into Massachusetts and gobbling up our utilities to ride roughshod over us.

If these gentlemen are right, this bill, if passed, will do them no harm. Moreover, it will put the Commonwealth in no worse position than it is now. Consequently, in my judgment, there is no sound reason why it should not be passed, and we will see what the result of its passage is.

December Customer-Ownership Sales Exceed $16,600,000

December sales of stock directly to customers consisted of 290,300 shares, valued at $16,603,000 and involving about 18,130 transactions.

The total value is somewhat below the monthly average for the year, but exceeds that of February, July, August and September and is less than 10 per cent below November sales. But it falls short, by more than 40 per cent, of the figures for the peak months, March and October.

The average value of the transactions was unusually high, being nearly $920. Three companies reported sales exceeding $1,000,000 for the month, the actual amounts being, respectively, $1,560,500, $1,544,300 and $1,400,000, and in addition one company had sales exceeding $3,800,000 in value.

The preceding estimates are based on returns from companies serving somewhat over 12,000,000 customers at the end of the year and thus accounting for about 87 per cent of all customers served by companies in the United States making it a practice to sell securities locally.

WINNIPEG ELECTRIC REPORTS UNUSUAL INCREASE IN OUTPUT.—During the year 1927 the combined output of the Winnipeg Electric and its associate, the Manitoba Power Company, amounted to 511,103,200 kw.-hr. and the peak load for the system was 112,000 kw. These figures mark an increase in output of 80 per cent over the previous year, and an increase in the peak load of 70 per cent over the previous year.

Industrial Development by New England Companies

The power committee of the New England Council recently reported on its survey of the activities of New England electric service companies in attracting industries to their respective territories. These companies were asked what they had done to attract industries to New England, what concrete results had been obtained and what plans were entertained for the future.

Of 53 New England companies reporting, only eleven claimed to have done any industrial development. None claimed to have obtained new industries solely through their own efforts. Their parts in industrial development included co-operation with chambers of commerce or railroads, advertising in newspapers, advertising in trade papers and magazines, listing available sites, issuing booklets, lending financial assistance and purchasing stock, purchasing and remodeling of buildings for industrial uses, solicitation by letter and in person of concerns interested in a particular territory, maintenance of exhibits at the various fairs and expositions, assignment of an industrial engineer or a sales department executive to industrial development activities, co-operation with industrial real estate brokers, and assisting communities in developing industrial survey programs. All of the reporting companies plan to continue such industrial development as they now conduct; all believe the work beneficial, but few have definite plans for additional efforts in the future.

Capital Set-Up of New Stone & Webster Group Announced

The new association formed by Stone & Webster, Inc., known as the Eastern Utilities Association, as announced elsewhere in this issue, will be capitalized at 2,000,000 no-par common shares and 2,000,000 no-par convertible shares. The companies immediately involved are the Blackstone Valley Gas & Electric Company, Edison Electric Illuminating Company of Brockton and Electric Light & Power Company of Abington & Rockland.

One share of Blackstone Valley $50 par common stock will be exchanged for 2½ shares of common stock in the association and 3¾ convertible shares. One share of Edison Electric $25 capital stock will be exchanged for one common share of the association and 1¾ convertible shares.

The association's common shares are entitled to dividends of $2 annually before any dividend is paid on convertible shares. When $2 common dividends have been paid the convertible shares will be entitled to annual dividends of $1. Thereafter each convertible share will receive one-half the amount received by each common share. When net earnings for two consecutive years have been not less than $2.40 a share on common and $1.20 on convertible

shares, the latter may be converted into common at the rate of two convertible shares for one common share.

Undeveloped Water Powers in North Carolina

It is evident from the rate at which the production of electrical energy in North Carolina has increased during the past decade that new power sources must constantly be developed for many years in the future. In the past ten years the installed water power in North Carolina has increased from 325,000 hp. in 1918 to nearly 610,000 hp. at the end of 1927.

The Department of Conservation and Development estimates that undeveloped sites now controlled by public utility companies in North Carolina total about 400,000 hp., in addition to the 295,000 hp. which they now have under construction. In addition, sites are known to the department which have been the subjects of engineering examination sufficient to indicate that some 505,000 hp. of undeveloped water power is available from them. If this be added to the preceding 695,000 hp. estimated as controlled by the public utilities, there is at least a total of 1,200,000 hp. in undeveloped water power available in North Carolina. In this estimate numerous undeveloped powers known to exist have not been included because they are at present not economical to develop.

PORTLAND ELECTRIC PAYS SPECIAL DIVIDEND.—Directors of the Portland Electric Power Company have declared a special dividend of $10.80 a share on the second preferred stock, payable 80 cents in cash and $10 in second preferred stock.

ILLINOIS POWER & LIGHT TO ISSUE DEBENTURES.—To raise funds for the acquisition of certain properties the Illinois Power & Light Corporation will issue, subject to the approval of the Illinois Commerce Commission, $2,000,000 principal amount of notes or debentures, maturing in twenty years and bearing interest at the rate of 5 per cent per annum. The officers and directors have also arranged to bring $5,000,000 of new money into the fixed capital of the company by the sale of additional common stock.

Company Reports

Name of Company	Gross Earnings Twelve Months Ended Jan. 31 1928	1927
Associated Gas & Electric	*$34,939,706	*$29,284,246
Bangor-Hydro-Electric	1,878,797	1,745,799
Baton Rouge Electric	1,032,755	973,374
Blackstone Valley Gas & Electric	5,914,838	5,566,986
Cape Breton Electric	654,265	622,033
Central Illinois Light	4,416,395	4,221,519
Cities Service	32,850,841	26,682,395
Columbia Gas & Electric & subs.	*96,851,668	*92,119,614
Columbus Elec. & Power	4,250,142	3,788,729
Commonwealth Power	53,550,307	49,473,699
Consumers Power	26,913,469	24,305,770
Eastern Texas Electric & subs.	7,278,115	5,768,124
Edison Electric Illg. Co. of Rochester	1,930,290	1,784,213
Elec. Light & Pwr. Co. of Abington & Rockland	627,537	579,233
El Paso Electric	3,008,357	2,863,182
Federal Light & Traction	*7,010,040	*6,623,587
Galveston & Houston Electric & subs.	5,066,762	4,671,420
Illinois Power	2,635,727	2,589,739
Lowell Electric Light	1,801,769	1,729,669
Northern Ohio Power	12,655,030	12,048,922
No. Texas Elec. & subs.	2,745,995	2,525,289
Ohio Edison	1,924,543	1,834,708
Portland Electric Power	12,103,187	11,817,801
Public Service Co. of New Hampshire & subs.	*3,536,711	*3,389,120
Puget Sound Power & Light & subs.	14,940,655	13,615,677
Savannah Elec. & Pwr.	2,223,012	2,240,597
Sierra Pacific Elec. & subs.	1,248,006	1,266,230
So. California Edison	*30,600,637	*27,846,518
So. California Edison	30,822,709	28,188,831
So. Indiana Gas & Elec.	3,036,886	2,902,501
Tampa Electric & subs.	4,705,593	4,882,944
Tennessee Electric Power	12,585,890	11,885,410
Virginia Elec. & Power	15,540,606	14,510,921

Stock Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday March 6	Low 1928	High 1928
ABITIBI PWR. & PAPER, com., new — no par	76¼	72	81
Ala. Pwr., $7 com. pf.—no par	114¼	114¼	115½
Allis Chalmers Mfg., 6% com.	121½	115¼	125
Aluminum Co. of Amer., com.	125	120	136
Aluminum Co. of Amer., 6% pf.	k107½	105½	107½
Amer & Foreign Pwr., 7% pf.—no par	107½	105½	108½
Amer. & Foreign Pwr., com.—no par	23½	22½	27
Amer. Bosch Magneto, com.—no par	20½	15½	22½
Amer. Brown Boveri Elec.†	15¼	14¼	18
Amer. Brown Boveri Elec., pf. $7	58	55	63
Amer. Gas & Elec., 6% pf.—no par	107½	106½	109
Amer. Gas & Elec., com. †—no par	143¼	117½	143½
Amer. Lt. & Trac., 6% pf.	115	116	120
Amer. Lt. & Trac., new com.	191½	170	191½
Amer. Pwr. & Lt., 6% pf.	107½	104	109½
Amer. Pwr. & Lt., com. †—no par	69½	62½	70
Amer. Pub. Serv., 7% pf.	a100	99	100
Amer. Pub. Serv., com. †	k 70	70	75
Amer. Pub. Utilities, 7% pfc. pf.	a 96	87½	96
Amer. Pub. Utilities, 7% pr. pf.	100	98	100
Amer. Pub. Utilities, com.	k 60	60	65
Amer. States Sec., A	a 5½	4	5½
Amer. States Sec., B	a 6	4½	6
Amer. Superpwr., 6% pfc pf.—25	30	28½	30
Amer. Superpwr., 6% 1st pf.	l103½	....	....
Amer. Sup'pwr., Class A†—no par, ex. rts.	38½	37	41½
Amer. Sup'pwr., Class B†—no par, ex. rts.	39	37½	43
Amer. Wtr. Wks. & Elec., 6% pf.	k104½	101½	105
Amer. W.W. & E., com. new—no par	56	52½	61
Anaconda Copper cap. $3	55½	53½	59½
Appalachian Electric Pwr., 7% pf.	109	108½	109½
Arkansas Pwr. & Lt. 7% pf	107½	108	109½
Assoc. Gas & Elec., $3.50—50	54	....	....
Assoc. Gas & Elec., pf.—$6—no par	95	96	98½
Assoc. G. & E., Class A, 10—no par.	47½	47	51½
BABCOCK & WILCOX, 7% com.	118	....	....
Binghamton L., H. & P., $6 pf.	105½	102	105½
Birmingham Elec., pf.—$7—no par	110	109½	111
Blackstone Valley G. & E., 6% pf.	k106	106	112
Blackstone Valley Gas & Elec., 10% com.—50	156	132	160½
Blaw-Knox, com.†	d103	91	105
Brazilian Trac., Lt. & Pwr., $7 com.	f203½	....	....
Brazilian Trac., Lt. & Pwr., com., new	f 52½	....	....
Broad River Pwr., 7% pf.	105½	105	107½
Brooklyn Edison, 8% com.	228	206½	235½
Buffalo, Niagara & East. Pwr., $1.60 pf.—25	l 26½	....	....
Buffalo, Niagara & East. Pwr. com. $1.20—no par	l 37½	....	....
CALIFORNIA ELEC. GENERATING, 6% pf.	k 98	98	101
California Ry. & Pwr., 7% pf.	k135	....	....
Carolina Pwr. & Lt., pf.—$7—no par	l110½	109	110½
Central & S. W. Util., $7 pf.—no par	a102½	99½	105½
Central & S. W. Util., pr. in. $7 pf.—no par	a104½	103½	108
Central Ark. Ry. & Lt., 7% pf.	104	105	107
Central Ill. Pub. Serv., $6 pf.	a 99	97½	99½
Central Ind. Pwr., 7% pf.	a 98½	94	98½
Central Maine Power, 6% pf.	95	....	....
Central Maine Power, 7%	109	109	112
Central Pwr. & Lt., 7% pf.	104½	104½	105½
Central States Elec., 7% pf.	111	104	112
Century Elec., 6% com.	b143	140	145
Chicago Fuse Mfg., com.—$2.50 no par	m 30	30	33½
Cincinnati Gas & Elec., 5% com.	g 99½	97½	100
Cities Service, $6 pf.—no par	l 96½	94½	96½
Cities Service, pf. B—no par	k 8½	8½	9½
Cities Service, pf. BB—no par	k 90½	88½	90½
Cities Service, com.—20	l 56½	54	56½
Cities Service, Bks. Shrs.—10	m 27½	22½	27
Cities Service Pwr. & Lt., 7% pf.	106½	105½	107
Cities Service Pwr. & Lt., 6% pf.	100	95½	100
Cleveland Elec. Illg., 6% pf.	113	113	115½
Cleveland Elec. Illg., 10% com.	360	350	370
Columbia Gas & Elec., 6% pf.	108	107½	110½
Columbia G. & E. com. $5—no par	91	89½	97½
Columbus Elec. & Pwr., $2 com.—no par	k 70	66	71
Columbus Elec. & Pwr., 7% pf.	113	....	....
Columbus Ry., Pwr. & Lt., 7% pf.	107½	....	....
Columbus Ry., Pwr. & Lt., 7 % pf. B	107	....	....
Columbus Ry., P. & L t. com.—no par	105	....	....
Commonwealth Edison, 8% com.	175	165	189
Commonwealth Pwr., 6% pf.	102½	102½	104½
Commonw'th Pwr., $2, com.—no par	69	62½	69
Conn. Lt. & Pwr., 8% pf.	119	120	123
Conn. Lt. & Pwr., 7% pf.	112	118	121
Cons. Gas of N. Y., pf.	102½	101½	102½
Cons. Gas of N. Y., com. $5—no par.	136	119½	139½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6% pf.	m112½	110½	113
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6½% pf.	e111½	110½	113
Cons. Gas, Elec. Lt. & Pwr. of Balti., 7% pf.	e110½	110½	115
Cons. Gas, Elec. Lt. & Pwr. of Balti., 8% pf.	m125½	125½	128½
Cons. Gas, Elec. Lt. & Pwr. of Balti., com. $3.00—no par.	e 69½	67½	72½
Consolidated Pwr. & Lt., 7% pf.	105	....	....
Consumers Pwr., 6% pf.	104½	105½	106½
Consumers Pwr., 6.6% pf.	106½	106	107
Continental Gas & Elec., 7% pr. pf.	111	108	111½
Conti. G. & E. com. $4.40—no par.	k235	240	265
Crocker Wheeler, com.†	30	24	27
Crocker Wheeler, 7% pf.	90	77	82
DALLAS PWR. & LT., 7% pf.	110½	110	111½
Dayton Pwr. & Lt., 6% pf.	108½	108½	109½
Derby Gas & Elec., 7% pf.	98	96	98½
Detroit Edison, 8% com.	178	166½	194½
Dubilier Condenser, com.—no par.	k 3½	2½	3½
Duke Pwr., cap.	k135	130	145
Duquesne Lt., 7% pf.	k116½	115½	116½
EASTERN NEW YORK UTIL., $7 pf.	k110½	111	112½
Eastern New York Util. com.	k 65	....	....
Eastern States Pwr. $7, com.	k 12	12	14½
Eastern States Pwr., pf.	k 97	98	99
East. Tex. Elec., 7% pf.	108	106	109
Edison Elec. of Boston, $12 com.	d257	252	268
El Paso Elec. 7% pf.	113	110	112½
Elec. Bond & Share, 6% pf.	l109½	109½	111½
Elec. Bd. & Sh. Sec., com. $1—no par	l 92	76	94½
Electric Household Util.†	a 17½	13½	15½
Elec. Investors, 6% pf.—no par.	102½	101	102½
Elec. Investors, com.†—no par.	44½	40½	45½
Elec. Pwr. & Lt., ctfs. pf.	110	106½	110
Elec. Pwr. & Lt., ctfs., 40% pd	k124½	120½	125½
Elec. Pwr. & Lt., ctfs., com.—no par	36½	28½	36½
Elec. Refrig. cap.†	14½	11½	15½
Elec. Ry. Securities, com.—no par.	6½	....	....
Elec. St. Battery com. $5.25—no par	77½	69	77½
Elmira Wtr., Lt. & R.R., 7% pf.	k106	104	107
Empire Pwr., pfc.†	k 32½	27½	35½
Engr. Pub. Serv. $7, pf.—no par	k109	107	110
Engr. Pub. Serv., com.—no par.	35½	33	36½
Eureka Vacuum Cleaner, com. $4—no par.	74½	69	79
FAIRBANKS MORSE, 7% pf.	k108	104	106½
F.-M., com.—$3—no par.	k 39½	32½	40½
Federal Lt. & Trac., com $1.40	51½	42	55
Federal Lt. & Trac., $6 pf.—no par.	k02½	98	105
Florida Pwr. & Lt., 7% pf.	107	105	107½
Ft. Worth Pwr. & Lt., 7% pf.	l114	113	114½
GALVESTON-HOUSTON ELEC. 6% pf.	77	75	78
Galveston-Houston Elec., com.	32	31	34
General Cable, Cl. A	63½	....	....
Gen. Elec. $3 com.—no par.	132½	124	138½
Gen. Elec., special—6%	11½	11½	11½
Gen. Gas & Elec. (Del.) com A $1.50—no par.	40½	35½	40½
Gen. G. & E. (Del.) pf. A $8—no par	k123	122½	126½
Gen. G. & E. (Del.) pf. A $7—no par.	k113½	108½	113½
Gen. G. & E. (Del.) pf. B $7	108	105½	108
Gen. Pub. Serv., $7 cum. pf., no par.	k117	110	110½
Gen. Pub. Serv., com., no par	19	16½	20½
General Public Utilities, $7 pf.	98½	98	99
Ga. Lt., Pwr. & Rys., com.	k 58	55	65
Ga. Ry. & Pwr., 6% pf.	k125	....	....
Ga. Ry. & Pwr., 7% pf.	k113½	....	....
Gt. Western Pwr., 7% pf.	h106½	....	....
IDAHO PWR., 7% pf.	109	109	110
Ill. No. Utilities, 6% pf.	k 96	96	98
Ill. Pwr. & Lt., 7% pf.	106	103	105½
Indianapolis Pwr. & Lt., 6% pf.	104½	102	107½
Indianapolis Pwr. & Lt., $7 pf.	103	100	105
Ingersoll Rand com.	90½	90	94
Int. Combus. Engr., com. $2—no par	48½	45½	55½
Int. Combustion Engr., 7% pf.	k103½	103½	105½
Int. Util., Class A—$3.50—no par.	k 45½	45	51½
Int. Utilities, Class B—no par.	k 7½	3½	10½
Interstate Pwr., pf.—$7—no par.	101½	199	102
Interstate Pub. Serv., 7% pf.	103	103	106
Iowa Ry. & Lt., 7% pf.	k100	02	103
JERSEY CENTRAL PWR. & LT. CO., 7% pf.	108	105	107
Johns-Manville, com.†—no par.	116½	114	116½
Johns-Manville, 7% pf.	m119½	119½	120

Stock Exchange: aChicago; bSt. Louis; cPhiladelphia; dBoston; eBaltimore; f Montreal; gCincinnati; hSan Francisco; iPittsburgh; jWashington. kBid price Saturday, March 3. lBid price Wednesday, March 7. mLatest quotations available. †Dividend rate variable.

Stock Quotations of Electric Light and Power and Manufacturing Companies (Continued)

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday March 6	Low 1928	High 1928
KANSAS CITY PWR. & LT. pf. $7	k116¼	115	116¼
Kansas Gas & Elec., 7% pf.	l109¼	107	109
Kentucky Hydro-Elec., 7% pf.	k103	100	104
Kentucky Sec., 6% pf.	92	94	98
Kentucky Sec., 5% com.	150	140	150
Kentucky Utilities, 6% pf.	k102	100	103
LACLEDE GAS LT., 10% com.	k200	200	260
Lehigh Pwr. Sec., com.—no par	25¼	19¼	27¼
Long Island Ltg., 7% pf.	112	110¼	112¼
Long Island Ltg., 6% pf.	106¼	....	....
Long Island Ltg., com.†—no par	k178	170	185
Los Angeles Gas & Elec., 6% pf.	108	105	109
Louisville Gas & Elec., cl. A. $1.75	28¼	28	29¼
MAN. ELEC. SUPPLY, cap. $5—no par	52¼	50	54¼
Manilla Elec., com.†—no par	k 47	45¼	50
Maytag Mfg.,com.50—no par,	32¼	30¼	34½
Memphis P. & L., pf.—$7—no par	k109½	109	111
Metropolitan Ed., pf.—$6—no par	106¼	103	107¼
Metropolitan Ed., pf.—$7—no par	109	109	111
Metropolitan Ed., com. $5—no par	k140	....	....
Middle West Utilities, 7% pf.	a122	116¼	124¼
Middle West Util., 7% pr. lien	a125¼	125	129¼
Middle West Util., com. $6—no par	a129¼	123¼	135
Midland Utilities, pr. in. 6% pf.	a 95¼	94¼	96¼
Midland Utilities, 7% pf. A	a 91	90¼	91¼
Milwaukee Elec. Ry. & Lt., 7% pf.	k103	100	103
Milwaukee Elec. Ry. & Lt., 6% pf.	k 99	98	101¼
Minn. Pwr. & Lt., 7% pf.	l109	107	109
Miss. River Pwr., 6% pf.	108	94	108
Miss. River Pwr., 3% com.	m 62	....	....
Mohawk Hudson Pwr., 1st pf.—$7—no par	k107	100	109
Mohawk Hudson Pwr., 2d pf.—$7—no par	k104	100	109
Mohawk Hudson Pwr., com.—no par	30	29¼	31¼
Montana Pwr., 5% com.	165¼	102¼	167¼
Montreal Pwr., 7¼% com.	f 90¼	....	....
Mountain States Pwr., 7% pf.	k103	97	103
Mountain States Pwr., com.†	17	....	....
NASSAU & SUFFOLK LTG., 7% pf.	109¼	98	110
National Carbon, 8% pf.	m138¼	138	139
National Elec. Pwr., A†	a 31¼	27¼	32¼
National Lt., Ht. & Pwr., com.	k 24	20	30
National, Light, Ht. & Pwr., 5% pf.	k 72	70	80
National Pwr. & Lt., pf.—$7—no par	k109½	101	111
National Pwr. & Lt., com.†—no par.	25¼	21¼	27¼
National Pub. Serv., 7% pf.	102¼	99	103
National Pub. Serv., 7% ptc., pf.	114	108	115
National Pub. Serv., A com. $1.60—no par	25¼	22	27¼
National Pub. Serv., B com.—no par	k 27	24¼	30
Nebraska Pwr., 7% pf.	l110	110	111¼
Nevada-Calif. Elec., com.	k 35	22	37
New Brunswick Pwr., 4% pf.	k 60	60	70
New Eng. Pub. Serv., pr. in. pf. $7	k110	98¼	104
New Eng. Pub. Serv., pf. $7	108	95	100
New Orleans Pub. Serv.—7% pf.	108¼	106	110
N. Y. & Queens Elec. Lt. & Pwr., 5% pf.	100	91	100
N. Y. Central Elec., 7% pf.	k103	101	104
New York Power & Light 7% pf.	114¼	....	....
New York Power & Light, 8% pf.	m114	....	....
Newport News & Hampton Ry., Gas & E. e. 5% com.	109	110	115
Newport News & Hampton Ry., Gas & Elec., 7% pf.	109	110	115
Niagara Falls Pwr., 7% pf.—25	28	28	28¼
No. Amer., 6% pf.—50	k 55	53¼	55
No. Amer., com.—10	60¼	58¼	62¼
No. Amer. Edison, $6 pf.—no par	103	102¼	105¼
No. Caro. Pub. Serv., pf.—$7—no par	109	93	105
Northeastern Pwr., com.	20¼	19¼	23
No. N. Y. Utilities, 7% pf.	107	103	109
No. Ohio Pwr., com.—no par	24¼	18	24¼
No. Ont. Lt. & Pwr., 6% pf.	k 98¼	94	99¼
No. Ont. Lt. & Pwr., 4% com.	k 72	73	78
No. States Pwr. (Del.), 7% pf.	k108	101	110
No. States Pwr. (Del.), 8% com.	134¼	123	136¼
No. Texas Elec., 6% pf.	58	45	70
No. Texas Elec., com.	18	5	36
OHIO BRASS, com. B $4—no par.	99	89	99½
Ohio Brass, 6% pf.	k107	106	111
Ohio Pwr., 6% pf.	106¼	104	107½
Ohio Pub. Serv., $6 pf.	k102½	95	102
Ohio Pub. Serv., 7% pf.	111	107	111
Ohio River Edison, 7% pf.	109	106	109¼
Oklahoma Gas & Elec., 7% pf.	112¼	....	....
PACIFIC Gas & ELEC., 6% pf.	27	26¼	28¼
Pacific Gas & Elec., 8% new com.	45¼	43¼	49¼
Pacific Pwr. & Lt., 7% pf.	l109	106	109
Penn Cent. Lt. & Pwr., $5 pf.—no par	c 80	79¼	80
Penn-Ohio Edison, 6% pf. no par	94¼	93	96
Penn-Ohio Edison, 7% pf.	106¼	106¼	109
Penn-Ohio Pwr. & Lt., 7% pf.	109½	99	110
Penn Pwr. & Lt.—$7—no par.	l110½	109¼	110½
Penn Wtr. & Pwr., $2.50 com., new	e 69	68	72½
Phila. Co., 5% pf.-50	k 46¼	46¼	48¼
Phila. Co., 6% pf.—50	53¼	52	53¼
Phila. Co., com.—50	159¼	149¼	163
Phila. Elec., 8% com.—25	c 57¼	55¼	59
Portland Elec. Pwr., 7% pf.	103	100	103½
Portland Elec. Pwr., 6% pf.	95	78	84
Portland Elec. Pwr., 6% 2d pf.	85	55	70
Portland Elec. Pwr., com.	50	....	....
Potomac Elec. Power, 6% pf.	l111	....	....
Pwr. Sec., pf.—no par	k 58	50	60
Pwr. Sec., com.—no par	k 12	5	15
Public Serv. of Colorado, 7% pf.,	105	....	....
Pub. Serv. of N. J., 6% pf.	105¼	103¼	106¼
Pub. Serv. of N. J., 7% pf.	119¼	118	120¼
Pub. Serv. of N. J., $2 com.—no par	44¼	41¼	45
Pub. Serv. of No. Ill., 6% pf.	a111¼	110	113¼
Pub. Serv. of No. Ill., 7% pf.	a119	119	121
P. S. of No. Ill., com. $8—no par.	a170	159¼	180
Pub. Serv. of No. Ill., $8 com.	a169	159¼	180
Pub. Serv. of Okla., 7% pr. in.	k105	100	107
Pub. Serv. Elec. & Gas, 6% pf.	k109¼	109	110¼
Puget Sound Pwr. & Lt., 7% pf.	k110	105	109
Puget Sound Pwr. & Lt., $6 pf.—no par	k 98	92	98½
Puget Sound Pwr. & Lt., com.	k 43	34¼	50
RADIO COPR. OF AMER., $3.50 pf.—50	55½	54¼	57¼
Radio Corp. of Amer., com.—no par.	100¼	85¼	104¼
Rhode Island Public Service, pf. $2—no par	m 31¼	30¼	31¼
Rochester Gas & Elec. 6% pf. D.	k105	105¼	106¼
Rochester Gas & Elec., 7% pf. B.	107	105	107
Rochester Gas & Elec., 6% pf. C.	105	105¼	106¼
SAN JOAQUIN Lt. & Pwr., 7% pr. pf.	k114	110	115¼
St. Joseph Ry., L., H. & P., 5% pf.	k 75	70	75
Servel, Inc.	7	4¼	7¼
Sierra Pacific Elec., 2% com.	k 36	29	38¼
Sioux City Gas & Elec., 7% pf.	107	100	108¼
Southeastern Pwr. & Lt., pf.—$7 no par	l 108¼	....	....
Southeastern Pwr. & Lt., ptc. pf.	l 89	....	....
Southeastern Pwr. & Lt., com.—no par	42¼	40¼	44¼
So. Calif. Edison, 8% pf.	k 45¼	38¼	41
So. Calif. Edison, 7% pf.	k 29	27¼	29¼
So. Calif. Edison, 6% pf.	k 26¼	25¼	28
So. Calif. Edison, 8% com.	47¼	43¼	47¼
Southern Cities Utilities, 7% pf.	k 75	75	78
Southwestern Lt. & Pwr., A $3.	70	60	65
Southwestern Lt. & Pwr., B.	65	60	65
Southwestern Lt. & Pwr., $6 pf.	91¼	88	92¼
Southwestern Pwr. & Lt., 7% pf.	k111¼	103	113
Standard Gas & Elec., 8% pf.	k 66	65	68
Standard Gas & Elec., 7% pr. pf.	111¼	108	113
Standard G. & E., com. $3.50	62¼	57¼	65
Standard Power & Light, com.	44	29¼	45
Standard Pwr. & Lt., 7% pf.	k105	98	105
Staten Island Edison, pf.—$6—no par	102¼	99	103¼
Superheater, $6 com.—no par	167	162	175
Syracuse Lighting, 7% pf.	k110	103	111
Syracuse Lighting, 8% pf.	k117½	114	119
TAMPA ELEC., com. $2	62	62	64
Tenn. Elec. Pwr., 6% pf.	103½	92	103
Tenn. Elec. Pwr., 7% pf.	109½	107	110
Terre Haute, Ind. & East. Trac., 5% pf.	k 10	....	....
Terre Haute, Ind. & East. Trac., com.	k 1	1	3
Tex. Pwr. & Lt., 7% pf.	l114	113½	115
Tide Water Pwr., 8% pf.	111	108	112
Timken Roller Bear., com.—$4 no par	117½	112½	134
Toledo Edison, 7% pf.	109½	108	111
Toledo Edison, 6% pf.	k103½	95	105
Toledo Edison, 6% com.	k100	93	102
Tri-City Ry. & Lt., 6% pf.	k100	96	99
UNITED GAS & ELEC., 6% pf.	100	98	103
United Gas & Elec. (N. J.), 5% pf.	75	70	77
United Gas Impr., 8% com.—50	cl15½	111½	117½
United Lt. & Pwr., pf.—$4—no par.	a 56½	53	56½
United Lt. & Pwr., pf.—$6.50—no par	a 99	95	100
United L. & P., com. A .48—no par.	a 17	14	17¼
United L. & P., com. B .48—no par.	k 24¼	20	24¼
Utah Pwr. & Lt., 7% pf.	l 111	109¼	111½
Utica Gas & Elec., 7% pf.	105	105	106½
Utica Gas & Elec., 8% com.	k200	215	225
Utilities Pwr. & Lt., 7% pf.	100¼	98	101¼
Utilities Pwr. & Lt., com. A $2.	32	28¼	32
Utilities Pwr. & Lt., com. B $1—no par	26	18¼	26
VERMONT HYDRO-ELEC., 7% pf.	k100	95	100
Virginia Elec. & Pwr., 7% pf.	k111½	108	111
WAGNER ELEC., 7% pf.	b 99½	96½	99½
Wagner Elec., com.—no par.	b 41	37	41
Washington Ry. & Elec., 5% com.	j485	....	....
Washington Ry. & Elec., 7% pf.	j103½	....	....
Washington Wtr. Pwr., 8% com.	k225	175	235
West Penn Elec., 7% pf.	112½	109½	114¼
West Penn Elec., Cl. A $7.	109	106½	110½
West Penn Pwr., 7% pf.	115½	114¼	116¼
West Penn Pwr., 6% pf.	110½	109½	113
West Virginia Lt., Ht. & Pwr., 7% pf.	k 95	94	100
Western Pwr., 7% pf.	k102	98	105
Western States Gas & Elec., 7% pf.	104	101	106
Western States Gas & Elec., com.	38	....	....
Westinghouse Elec. & Mfg., 8% com.—50	94¼	88¼	100¼
Weston Elec. Instrument, Cl. A $2—no par	33	30¼	34
Weston Elec. Instrument, com.—no par	k 12¼	12¼	14¼
Wheeling Elec., 6% pf.	k104	95	104
Worthington Pump, 7% pf. A	k 50	46¼	55
Worthington Pump, 6% B.	k 44¼	41	49½
Worthington Pump, com.	30	28	34¼
YALE & TOWNE com. $5—25.	k 74¼	71¼	75

Stock Exchange: aChicago; bSt. Louis; cPhiladelphia; dBoston; eBaltimore; fMontreal; gCincinnati; hSan Francisco; iPittsburgh; jWashington. kBid price Saturday, March 3. lBid price Wednesday, March 7. mLatest quotations available. †Dividend rate variable.

New Capital Issues

First mortgage and refunding 4½ per cent gold bonds, series F, of the Interstate Public Service Company to the amount of $12,554,000 were offered during the past week at 94½ and interest, yielding about 4.85 per cent. These securities, dated March 1, 1928, are a direct obligation of the company, and are secured by a mortgage covering as a direct lien all fixed property now owned or acquired in the future. Proceeds will be used toward reimbursing the company for refunding bonds bearing higher coupon rates and for other corporate purposes.

The Oklahoma Power & Water Company issued first mortgage 5 per cent twenty-year gold bonds, series A, at 96½ and interest, yielding about 5.30 per cent, a piece of financing involving $4,500,000.

Six-dollar cumulative preferred stock was issued by the National Power & Light Company at $102 per share and accrued dividend, 101,126 shares being offered. Another offering of six-dollar cumulative preferred stock (no par value) was made by the West Texas Utilties Company at 96 per share and accrued dividend to yield 6.25 per cent.

Iowa Power & Light Company this week sold an issue of $6,000,000 first mortgage 4½ per cent bonds, series A, due 1958, at 95½ and interest to yield 4.80 per cent. Proceeds will be used to retire $5,000,000 of 5½s and 6s due May 1, 1928, as well as for additions and extensions.

AMERICAN GAS & ELECTRIC INCREASES CAPITAL.—The American Gas & Electric Company, New York City, has filed a certificate in the office of the Secretary of State increasing its number of shares from 2,850,000, non-par value, to 4,600,000, non-par value.

MASSACHUSETTS UTILITY INCREASES CAPITAL.—Greenfield (Mass.) Electric Light & Power Company at its recent annual meeting voted to increase preferred stock from $300,000 to $375,000, the new stock to consist of 3,000 shares of par value of $25 each. Proceeds from this issue will be used to reduce the company's floating indebtedness.

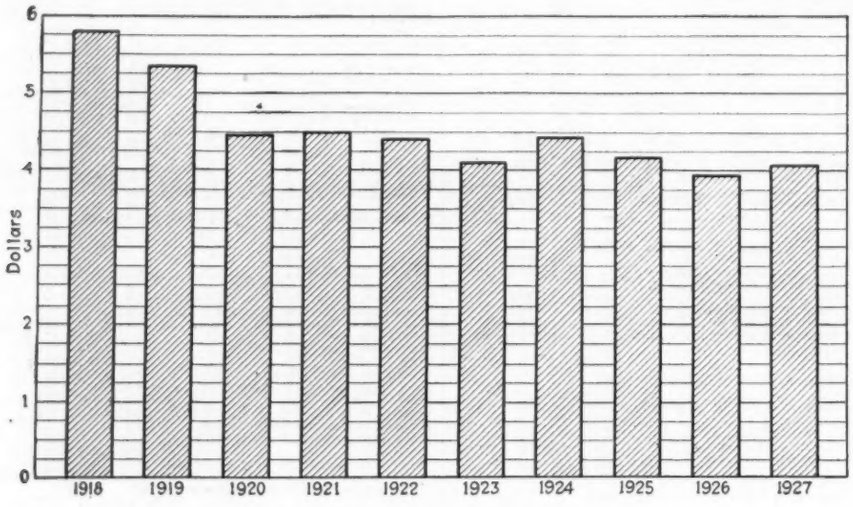
LYNN GAS & ELECTRIC PETITION APPROVED.—The Massachusetts Department of Public Utilities has approved the petition of the Lynn Gas & Electric Company for the issuance of 19,500 shares of additional stock at $25 per value to be offered to stockholders at $75 per share.

Western Massachusetts Companies Gain 10 Per Cent in Kilowatt-Hour Sales

ANTICIPATION of an excellent showing by the Western Massachusetts Companies and constituent properties during 1927 have been realized in the first annual report of this organization. This voluntary association came into being Jan. 15, 1927, and the properties embraced in the report consist of the Turners Falls Power & Electric, Greenfield Electric Light & Power, Lee Electric, Agawam Electric, Ludlow Electric Light, Amherst Gas, Easthampton Gas, Pittsfield Electric and United Electric Light (Springfield) companies. On Jan. 1, 1928, there were 940,528½ shares of common stock without par value in the association, or 96.4 per cent of the total outstanding shares of common stock in the constituent companies. The common shares were held by 4,781 stockholders and the present dividend rate is on the basis of $2 per share annually. There are no bonds or other evidences of indebtedness outstanding. The operating utilities controlled have combined assets of $36,082,403 and did a gross business in 1927, eliminating intercompany sales, of $8,189,877. They serve a population of about 400,000 and supply many diversified power requirements. Total energy sales after intercompany transactions were 403,814,360 kw.-hr., an increase of about 10 per cent over 1926. The total generating capacity of the plants of this group is 64,000 kw. in hydro and 71,500 kw. in steam power. During the past decade the business of these companies has increased 147 per cent.

The consolidated earnings statement of the operating companies for 1927 shows operating expenses of $3,270,926 and taxes of $1,295,757, net of $3,623,194 and total earnings (including other income of $136,694) of $3,759,889. Interest deductions were $256,977, leaving a balance of $3,502,911. The retirement reserve was $1,002,274, set aside by constituent companies in 1927 to meet the cost of plant and equipment replacements. Dividends of constituent companies totaled $2,829,415, leaving after balance $673,496. Other charges deducted were $182,070, leaving as addition to surpluses of constituent companies $491,425. The statement of the voluntary association itself showed total income, $1,036,160; dividends paid, $1,022,164, and balance to surplus, $13,996.

Since 1918 the investment in the combined constituent companies per dollar of gross income has fallen from about $5.80 to $4 and the total investment has increased from about $18,000,000 to $33,000,000. Gross income has risen from about $3,250,000 to $8,189,877 and accumulated reserves and surplus from $1,800,000 to $9,950,000 in round numbers. Sales of permanent power have increased from about 125,000,000 to 295,000,000 kw.-hr. The number of employees has increased from approximately 550 to 720. During the past year the affiliated companies expended $2,355,700 for additional electrical equipment and other plant items, and at present the United company, Springfield, is building a $900,000 main receiving substation in West Springfield and is increasing the capacity of its Indian Orchard hydro plant by 2,600 kw. at a cost of about $260,000.



Investment per dollar of gross income

Norway Enters American Market

Oslo Gas & Electricity Works (Oslo Gas og Elektricitetsverker), Norway, made an offering during the first week of March of 5 per cent external sinking fund gold bonds, totaling $6,000,000, at 95¼ and interest to yield 5.30 per cent. The Oslo Gas & Electricity Works was organized in 1920 by resolution of the Municipal Council of the city of Oslo for the purpose of combining under one management the gas and electric producing and distributing systems formerly operated by municipal government. The issue was oversubscribed.

Continued Improvement in Utilization of Fuel

Revised statistics of the total annual production of electricity by public-utility power plants in the United States, compiled by the U. S. Geological Survey, indicate an output of 79,767,000,000 kw.-hr. in 1927, an increase of 8 per cent over the output for 1926. Of this quantity 37 per cent was produced by the use of water power, an increase of 1.6 per cent over the proportion for 1926. In kilowatt-hours the electricity produced by the use of fuel increased about 5½ per cent, and the electricity produced by water power increased about 13 per cent. It would have required about 27,000,000 tons of coal to generate the electricity which was produced by the use of water power. These figures cover not only energy for light and power, but include the output of other public utility plants as well.

The improvement in the average utilization of fuels that has been brought about by improvements in plant design and operation during the last few years continued in 1927. The operators of public-utility power plants performed the remarkable feat of generating about 2,500,000,000 more kilowatt-hours of electricity by the use of fuel in 1927 than in 1926 by the consumption of about 150,000 tons of fuel less than was used in 1926.

From 1919 to 1927 the average quantity of coal required to produce a kilowatt-hour of electricity has decreased from about 3.2 to about 1.8 lb. This is a notable performance, not only in the total amount of the reduction during the eight-year period—1.4 lb., or a reduction nearly as great as the present average rate of consumption per kilowatt-hour, but especially in the continuation of the improvement during recent years, when the limit of achievement in utilization of fuel under present conditions of generation of electricity has almost been reached. The reduction in the average fuel rate from 1926 to 1927 was about 0.12 lb., or almost 2 oz., per kilowatt-hour generated. With coal costing $4 a ton, it would require the savings on the generation of about 4,000 kw.-hr. of electricity to amount to $1 in fuel. The total consumption of electricity by ten average domestic customers in 1927 about equaled 4,000 kw.-hr. The apparently insignificant saving of 0.12 lb. of coal per kilowatt-hour amounted to about 3,000,000 tons of coal for the year, or, at $4 a ton, $12,000,000.

Tables accompanying the Geological Survey statement show the output and fuel consumption for 1927 for the United States and its main divisions, with the annual figures of output and fuel consumption and the average rates of fuel consumption per kilowatt-hour from 1919 to 1927.

Business News and Market Conditions

Industrial, Agricultural and General Employment Prospects

Survey of Year's Business Indicates Steady Sales—New High Levels Expected in 1928—Situation Generally Promising Throughout the Country

SOME of the high points in a bulletin issued by the United States Department of Labor entitled "Industrial, Agricultural and General Employment Prospects for 1928" are summarized by states as follows:

Alabama—Outlook promising; increase expected in iron, steel and coal; textiles stationary; much public work and commercial building planned; farmers optimistic.

Arizona—Increased employment predicted in the major industries; agricultural activities to increase; several large construction projects.

Arkansas—Outlook very favorable, except for coal mines, textiles and lumber mills; activity in highway construction and building.

California—Industrial activity expected to reach normal first half of 1928; several large industrial plants starting; activity in highway and heavy construction, but no increase in building trades.

Colorado—Increase expected in several major industries and agriculture.

Connecticut—Metal-working and silverware to continue at capacity; improvement in textiles; increase in leather, paper and hat industries; $11,000,000 for highway work.

Delaware—Activity expected in machinery, shipbuilding and leather; less bright outlook in fiber industry; large building and public works program previously begun to continue.

District of Columbia—Large government departmental buildings started.

Florida—Major industries expect normal operating schedules; much road construction.

Georgia—Establishment of new industrial plants to continue; $35,000,000 for roads and municipal improvements.

Idaho—Major industrial plants report a satisfactory outlook.

Illinois—Increase in industrial employment anticipated; metal industries more optimistic; automobiles and railroads demand increased steel; much building.

Indiana—Gradual expansion in industrial employment anticipated; large increase in automobile production and in demand for steel.

Iowa—Improvement in industrial conditions; $28,300,000 in road construction; satisfactory building program.

Kansas—Employment to equal or surpass 1927; employment by public utilities will continue at same rate; building operations slightly under 1927.

Kentucky—Textiles expect increased business; coal mining curtailed; lumber stationary; building prospects fair; activity in highway and other construction.

Louisiana—Major industries predict better year than 1927 except lumber, textile and oil; increase in public work and farm acreage.

Maine—Textile outlook uncertain some places, operating to capacity elsewhere; increase in iron and shoes, but not in paper or lumber; farmers gloomy.

Maryland—Major industry prospects fairly satisfactory.

Massachusetts—Rubber, footwear, fabrics, printing, wire, leather, and paper to continue at capacity; cotton mill situation improved; normal increase anticipated in other industries.

Michigan—General industrial increase expected, particularly automobiles; 350 miles of concrete highway; slight decrease in building.

Minnesota—Outlook distinctly favorable; iron production to continue; highway construction, city improvements, lumbering and agriculture good; heavy business expected by flour mills and farm machinery manufacturers.

Mississippi—Outlook good except lumber and textiles.

Missouri—Outlook improves over 1927; automobile assembling plants to resume; iron and steel operations to increase; mineral shipments higher; building activity good.

Montana—Industrial prospects encouraging; industries, excepting lumber manufacturing, expect a slight increase; mining and oil development work anticipated; large construction projects planned; agriculture in good shape.

Nebraska—Rubber tire concerns working overtime; other assembling plants to resume; meat packing gains; large building and public works program contemplated.

Nevada—Industrial plants optimistic; 50 per cent increase in sugar beet acreage; decrease in building; extensive highway program.

New Hampshire—Shoe, textile and paper industries coming back to normal; others continue at maximum; normal building program; $3,000,000 for highway work.

New Jersey—Industrial conditions compare favorably with 1927; several industries continue on curtailed schedules; bright outlook in automobile lines; increase in iron and steel; textiles continue improving; large building program; $30,000,000 worth of bonds voted for state highway construction program.

New Mexico—Normal operations in major industrial plants and mining; building and other construction to increase; increase in highway construction.

New York—Prospect not particularly great; agricultural machinery, cameras, optical supplies, textile and shoe industries continue satisfactory; automobile industry to increase; part-capacity operations in locomotive, railroad equipment and electrical manufacturing plants; building program to continue.

North Carolina—Considerable construction work, including power plants and lines; major industries satisfactory.

North Dakota—Public works, power lines and railway construction in prospect; beet sugar production increasing.

Ohio—Outlook not altogether favorable; less building; $20,000,000 for highways; iron and steel, rubber goods and tires to show increase.

Oklahoma—Outlook, except coal mining, encouraging; industries expect improvement; textile and lumber companies are less optimistic.

Oregon—No increase anticipated; depression in lumbering continues and affects other industries.

Pennsylvania—Metal industries increase from curtailed to schedule; textile outlook favorable; less decrease in building, but much public work.

Rhode Island—High activity in metal and building trades to continue; increase in textiles; machinery to continue at maximum production; gradual pick-up in general.

South Carolina—New textile plants, satisfactory industry schedules; heavy construction and building activity.

South Dakota—Road and building construction active; prospects favorable.

Tennessee—Steady increase in textiles; building outlook good.

Texas—Much building and public work planned; textiles and lumber not particularly bright, but improving; farmers optimistic; increase in acreage.

Utah—Outlook fairly satisfactory; some increase in agriculture, live stock, highway construction and some lines of manufacturing.

Vermont—Optimistic, especially regarding marble, granite, talc and textiles; much reconstruction.

Virginia—New industrial plants near completion; prospects in nitrogen manufacture and artificial silk knitting; large highway work.

Washington—Optimistic; large pulp and paper mills and chemical plants to be erected; 150 new factories; building and heavy construction schedules big.

West Virginia—Continued increase in factory employment; airplane factories; increased public improvements; building to increase.

Wisconsin—Major industries expect fairly satisfactory schedules; fair prospects in building construction.

Wyoming—Slight increase in major industrial plants, oil refineries and sugar factories; material increase in agriculture and livestock; considerable construction.

> *Contrary to precedent established in former Presidential election years, when the business world stood by awaiting results before charting programs, the opposite is true at this time. . . . Industry and business will mark new high levels in 1928. . . . All signs point to the biggest year in the history of the automotive industry. Iron and steel point to marked increases over 1927. . . . Building construction will compare favorably with the previous year. The position of agriculture shows improvement. Railroads will undoubtedly enjoy normal business. . . .*
>
> FRANCIS I. JONES,
> *Director-General U. S. Employment Service, U. S. Department of Labor.*

Sales of Washing Machines by Quarters 1923-1927 (Except Electrics)

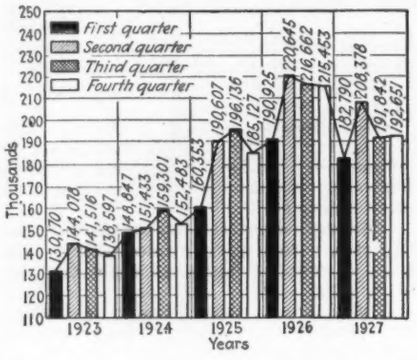
Electric Washing Machine Sales Shown Separately

(Data Supplied by American Washing Machine Manufacturers' Association)

Quarter	Hand-Power Machines					Gas and Power Machines					Water-Power Machines					Total (Including Electrics)				
	1923	1924	1925	1926	1927	1923	1924	1925	1926	1927	1923	1924	1925	1926	1927	1923	1924	1925	1926	1927
First	35,317	22,079	25,174	26,854	21,050	5,934	3,803	6,762	13,742	14,676	7,352	4,732	5,475	7,228	4,783	178,773	179,461	197,764	238,749	223,299
Second	30,811	20,470	25,314	24,516	16,655	6,319	4,310	9,034	19,103	24,091	7,758	4,023	5,844	8,226	5,584	188,966	180,236	230,799	272,496	254,708
Third	30,212	19,036	22,348	20,293	14,544	4,289	3,987	10,431	19,039	19,467	6,947	5,078	5,665	8,518	4,357	182,964	187,402	234,580	264,512	230,210
Fourth	19,063	20,748	20,922	17,905	13,721	3,568	4,842	9,518	14,645	26,487	6,498	3,729	3,789	5,299	3,430	167,726	181,802	219,356	253,302	236,289
Total	105,403	82,333	93,758	89,568	65,970	20,110	16,933	35,745	66,529	84,721	28,555	17,562	20,773	29,271	18,154	718,429	728,901	882,499	1,029,053	944,506

Washing Machine Sales Decrease in 1927

Sales of all types of washing machines in 1927 amounted to 944,506, with a retail value of $127,750,000. This compares with 1,029,053 machines in 1926, with a total retail value of $137,525,000. Electric washing machines showed a decrease of about 8 per cent in 1927 as compared with 1926, the total number of washing machines sold in 1927 being 775,661. In April, 1927, 78,993 electric washing machines were sold, the largest number in any one month during that year. Lowest monthly sales were recorded in January and were 55,319. The difference between the best and the poorest month was 23,674 machines, or 36 per cent of the monthly average, 64,638. The five months having sales above the monthly average were March, April, June, September and October. The accompanying table gives sales by quarters from 1923 to 1927 for all types of washing machines and the accompanying graph records the sales of electric washing machines for the same period.



Sales of electric washing machines by quarters, 1923 to 1927

Market Conditions

INDUSTRIAL equipment buying is active in the New England district. Orders amounted to about $275,000 and included a 6,000-kw. turbo-generator unit. Small motor sales are increasing and are up in volume to those of last year. An increase in appropriations for street lighting is noted throughout the district. Utility orders show an increase in the Eastern district, with substation equipment a feature of the demand. A New York company bought $320,000 worth of high-tension cable. The industrial demand continues active.

A satisfactory volume of small orders characterizes the business in the Southeast. Industrial plant orders and prospects are especially good. In the St. Louis district sales are at about a normal level and jobbers have been doing a slightly better business since March 1. Business is gradually increasing in the Middle West, though not to a marked extent. During February a large utility company bought at an average rate of $140,000 per day. On the Pacific Coast industrial business is especially active. A pulp mill in Gray's Harbor, Wash., ordered $12,000 worth of motors. A 10-ton pulp mill is to be built in South Bend, Wash., and a mining company in Tuolumne County will build a 3,294-hp. plant next July. Several sales of pumps and motors were reported for the irrigation and orchard districts in eastern Washington and Oregon.

Metal Markets Active—Some Price Improvement Noted

Copper and lead sales have been active. The tone of the copper market is improved and the 14.125 cents price (Connecticut delivery basis) of the leading producers, which has been more or less nominal for many weeks, has been realized on large tonnages. Lead has been particularly active, though the price in New York is virtually unchanged. Zinc has been quiet, but sellers have not pressed their offerings, and business has been done at somewhat higher levels than last week. Moderate consumer buying of tin, with little change in price, is reported. Copper can hardly be said to be firmly established at 14.125 cents delivered in Connecticut, even though an unusually good tonnage was sold on that basis. On Tuesday all prices between 14 cents and 14.125 cents, Connecticut, were realized and a fair quantity for Middle West delivery was placed at 14.25 cents. In some instances it is probable that special brands or special shapes were a factor in the sales at the high end of the range. One or two sellers were willing to shade 14.125 cents on Wednesday, but the rest are firm at that figure and most of the business has been done at 14.125 cents.

NEW YORK METAL MARKET PRICES

	Feb. 29, 1928 Cents per Pound	March 7, 1928 Cents per Pound
Copper, electrolytic	13.95	14.125
Lead, Am. S. & R. price	6	6
Antimony	10¼	10¼
Nickel, ingot	35	35
Zinc spots	5.825	5.875
Tin, Straits	51⅛	51⅛
Aluminum, 99 per cent	24.30	24.30

Base copper price March 7, 1928, 15¼ cents.

Good Volume of Small Orders Reported in Southeast

A reasonably satisfactory volume of small orders characterizes the electrical business in the Southeast. Virtually no orders for large equipment are being placed, though there is a satisfactory amount of that business in more or less immediate prospect. The largest central-station orders cover distribution and small power transformers for one company, totaling $17,000. The next order in point of size was for $7,300 worth of house-type meters. Another central-station order called for $4,500 worth of creosoted pine poles and bushings amounting to $1,700. The demand for meters and small transformers is generally good. One company in south Georgia ordered electric ranges, costing approximately $11,000, for use in a special sales campaign.

An order was placed last week by a new industrial plant in Georgia for inside wiring materials approximating $30,000, while an industrial plant in Tennessee ordered two electric welders costing $2,000. Bids have been asked on a textile mill project in Alabama for motors, transformers and regulators which will cost from $100,000 to $125,000. There is a considerable amount of industrial business, particularly in textile plants, now pending which should be announced within the next 30 to 60 days and contracts let at that time. One of these pending jobs is a silk mill to be constructed in Tennessee at a cost of $750,000. The improvement in construction lines is reflected in jobbers' sales. One of the most prominent jobbers states that his business for February was 25 per cent ahead of the same

month last year. Municipalities are buying in good volume, though the individual orders are generally small. One Georgia town ordered $2,000 worth of line construction materials, while another municipality purchased street lighting equipment amounting to $1,100.

Construction projects are as follows: The Uriah Ice & Gin Company, Pensacola, Fla., plans an ice and cold storage plant to cost $100,000. The Plainville Brick Company, Plainville, Ga., plans a power station to cost $25,000. The F. S. Royster Guano Company, Norfolk, Va., plans a new fertilizer plant at Wilmington, N. C., to cost $125,000. The Willys-Overland Company, Toledo, Ohio, plans a new assembling plant at Columbia, S. C., to cost $600,000. The Gillette Grain Company, Nashville, Tenn., plans a new grain elevator to cost $115,000. Huntsville, Ala., Milledgeville, Ga., and Richmond, Va., plan ornamental lighting systems.

Utility Orders Increase in Eastern District

Light and power companies are prominent in the market in the Eastern district and such business is showing marked improvement. Substation equipment continues as a feature of current commitments and inquiries are increasing. A central-station company in Brooklyn has placed an order for substation apparatus, including underground network protectors, totaling about $35,000. Wire and cable is more prominent in demand, following several weeks of dullness. A New York utility has contracted for a quantity of high-tension cable amounting to $320,000. A leading manufacturer of generating equipment reports a better volume of inquiries than at any time this year, with orders trending upward. A western Pennsylvania municipality has purchased a 500-kw. generator set and a New York central-station company will soon be in the market for a direct-current set of like capacity. A manufacturer of turbo-generators reports an order for a large unit for central-station service at San Francisco. Business in control apparatus is holding up well and out-door switching equipment is operating under more active call. High-tension line insulators are experiencing a sluggish market, with little change expected for several weeks.

Industrial demand shows little change. The call for motors and other apparatus is active. A manufacturer reports orders for 20-hp. motors for automobile plant service. Several paper mills in Michigan and Wisconsin are expected to place orders at an early date, and a rayon mill at Lewistown, Pa., is scheduled for heavy purchases for a plant addition to cost more than $1,000,000. Fractional-horsepower motors are in better demand and makers of smaller electrical appliances are receiving sizable orders. A manufacturer of electric refrigerators says that business has shown considerable improvement within the last few weeks as compared with earlier in the year.

The electrical market at Philadelphia is becoming more active. Central-station companies are making inquiries for substation and line equipment and good prospects appear ahead in these lines. Prime mover sales are slow. Industrial account shows betterment, particularly in connection with the iron and metal-working industries, which have been purchasing motors in larger-sized units. The local textile industries are showing expansion in their call for requirements for new installations.

Current construction activities are as follows: The Otis Elevator Company plans an addition to its plant at Yonkers, N. Y., to cost $200,000. Huschle Brothers, Inc., will add to its paper box plant at Long Island City to cost $125,000. The Public Service Electric & Gas Company will soon begin work on a two-story substation at Rahway, N. J. The Vacuum Oil Company plans an addition to its refinery at Paulsboro, N. J., to cost $100,000. Haverford College, Haverford, Pa., plans an engineering laboratory to cost $100,000. The Pennsylvania Power & Light Company will build a 66,000-volt transmission line from Berwick, Pa., to the Hanlock Creek plant of the Luzerne County Gas & Electric Company; surveys are also in progress for transmission lines in Hollenback, Dorrance and Dennison Townships. The Columbia Steel Company will make extensions in mill at Butler, Pa., to cost $1,000,000. The United States Engineer, Pittsburgh, will receive bids until March 28, for a hydro-electric plant at Lock 6, Allegheny River, near Clinton, Pa. The Allegheny Steam Heating Company, operated by the Duquesne Light Company, Pittsburgh, plans a new central power plant to cost $1,000,000. The Eastern Shore Public Service Company will build a transmission line from Salisbury to Vienna, Md.

Sales at About Normal Level in St. Louis District

No marked change is noted in the St. Louis district. An order was placed by a railway company for machine tool motors amounting to $5,000. Another for substation control and switching equipment amounted to $35,000 and a lot of oil switches and circuit breakers was purchased by another central-station company for $22,000. One manufacturing company reports $150,000 worth of miscellaneous business in the southwestern part of the district for the first week in March. Indications of a slowing down of business in the Illinois coal mining region is probably owing to labor uncertainty after April 1. Jobbers are doing a slightly better volume of business since March 1.

Construction projects are as follows: The Camden Ice & Coal Company, Camden, Ark., plans an ice and cold storage plant to cost $90,000. The Arkansas Power & Light Company plans extensions in transmission lines at Tellville and Cotter, Ark. The Arkansas Cold Storage Company, Little Rock, plans an ice and cold storage plant to cost $100,000. The Bayou State Refining Corporation, Losston, La., will extend its oil refining plant to cost $200,000. Armour & Company, Chicago, plans a branch packing plant at Elk City, Okla., to cost $150,000. The Texas Ice & Fuel Company, Houston, plans a 40-ton ice plant on Canal Street, to cost about $60,000. The Texas-Louisiana Power Company, Pecos, Tex., has approved plans for addition to its power plant. Muskogee, Okla., and San Antonio, Tex., plan ornamental lighting systems.

Business Gradually Increasing in Middle West

The volume of business in the Middle West is gradually increasing, although not to a marked extent. Spring activity in industrial plants is becoming more noticeable and optimism is strongly evident. February production figures in the automotive industry are encouraging and considerable buying is reported in the agricultural districts. The coal situation in southern Illinois does not show any immediate signs of improvement, but the building situation has improved considerably. The various utility companies continue to be an important factor in general business, their purchases adding materially to the volume of business transacted. While the conservative policy of hand-to-mouth buying is still generally in effect, a somewhat less restricted attitude is being assumed toward future committments. General purchases during February were larger, one utility company averaging $140,000 per day. Among the interesting items placed this week were a motor order valued at $20,000 and an order for 400 assorted distribution transformers, 25, 37½ and 50 kva. Considerable construction work is under way. Small orders placed for such work are in excess of $50,000. Jobbers' sales are generally satisfactory. Municipal and railroad business is quite large. Appliances are moving in fair volume and the campaign last month on waffle irons resulted in volume sales of this appliance.

Construction projects are as follows: Columbia Mills, Inc., Chicago, plans a mill at West Pullman, Ill., to cost $200,000. The Reliance Dye & Stamping Company, Chicago, Ill., plans a three-story addition to cost $250,000. The Chicago, Burlington & Quincy Railroad Company plans a power plant to cost $50,000. The Caterpillar Tractor Company, East Peoria, Ill., will erect an addition to cost $200,000. The University of Illinois, Urbana, plans a testing laboratory to cost $400,000. The Interstate Public Service Company, Indianapolis, Ind., plans purchase of lines in Johnson, Bartholomew and Shelby counties. The Rollins Hosiery Company, Des Moines, Iowa, plans an addition to cost $100,000. Emmetsburg, Iowa, plans a municipal power plant. The Western States Public Utilities company will add to its power plant at Sheldon, Iowa, at a cost of $80,000. The Iowa Railway & Light Company will erect a power plant at Webster City, Iowa, to cost $38,000. Royal Oak,

Mich., plans a new pumping plant for waterworks service, to cost $80,000. The Detroit Edison Company plans a one-story substation at Royal Oak, Mich., to cost $140,000. The St. Joseph Paper Board & Box Company, St. Joseph, Mich., plans a new mill to cost about $300,000. Earl Dickason, Chillicothe, Ohio, plans a baking plant to cost $125,000. The Vermont Marble Company, Cleveland, has filed plans for a plant on Harvard Avenue, to cost $100,000. Dayton, Ohio, will take bids for a central station for fire alarm and police signal systems, to cost about $50,000. The Defiance Dairy Products Company, Defiance, Ohio, plans a plant to cost $275,000. E. I. du Pont de Nemours & Company, Wilmington, Del., will extend its powder mills at Barksdale, Wis., to cost $400,000. The Wisconsin Power & Light Company plans a two-story storage and distributing plant addition at Berlin, Wis., to cost $25,000; also a similar plant at Portage, Wis. Evanston, Ill., Niles Center, Ill., and Cedar Rapids, Iowa, plan ornamental lighting systems.

Industrial Business Active on Pacific Coast

Some excellent industrial business is reported on the Pacific Coast. A pulp mill in Gray's Harbor, Wash., bought $12,000 worth of motors. A 10-ton pulp mill is to be built in South Bend, Wash. A mining company also will build a 3,294-hp. plant next July in Tuolumne County. A Mexican mining company is in the market for motors and supplies for Mazatlan shipment. Ten elevator equipments and a distribution switchboard with a total value of $60,000 have been sold by the Westinghouse Electric Manufacturing Company for San Francisco installation. Other interesting orders include two motor-generator sets, valued at $5,000, for motion-picture service and two 200-hp. motors for a Honolulu sewage disposal plant. Another Honolulu order covers transformers, watt-hour meters, etc., valued at $8,000. Power company orders include one carload insulators for $7,500, 200 assorted 7,500-volt line switches and 10,000 assorted steel pins. The city of Anaheim is in the market for transformers and meters and the city of Los Angeles for meters, instruments and a carload of line switches.

Sales of motors and heavier apparatus in Seattle are reported from fair to good. The majority of sales cover pumps and motors for irrigation and orchard districts in eastern Washington and Oregon and small motors for replacements and minor additions to lumber mills and woodworking plants in northwest Washington and Gray's Harbor. The sale of four motor-driven pumps for a pump mill in Whatcom County is reported. Buying for pulp and paper mills, including one new plant and additions to two or more is expected this spring. The Great Northern Railway Company has awarded a contract for approximately $100,000 worth of insulators and line materials in connection with the completion of electrification of its main line from Wenatchee to the Cascade tunnel.

Construction projects are as follows: The Belmont Copper Company, Superior, Ariz., plans a flotation plant to cost $200,000. The Pacific Gas & Electric Company plans improvements at Lodi, Calif., to cost $75,000; also in vicinity of Yuba City, to cost $80,000. Riverside, Calif., is planning a 5,000-kw. municipal power plant. The National Ice & Cold Storage Company, San Francisco, plans an ice plant at Hollister, to cost $80,000. The Monolith Portland Cement Company will make extensions in its mill at Tehachapi, Calif., to cost $250,000. Walter H. Wheeler, Minneapolis, Minn., is preparing plans for a power plant at Polson, Mont., to cost $75,000. The California Petroleum Company, Sunburst, Mont., will extend its refining plant to cost $200,000. The Doernbecker Manufacturing Company, Portland, Ore., will add its furniture plant at a cost of $400,000. The San Juan Pulp Manufacturing Company, Bellingham, Wash., plans an addition to cost $100,000. Los Angeles and Santa Maria, Calif.; Great Falls, Mont.; Aubuquerque, N. M.; Oregon City, Ore., and Wenatchee, Wash., plan ornamental lighting systems.

Industrial Equipment Buying Active in New England

An encouraging increase in buying is reported in the New England district. New installations and replacements of power equipment are being considered and a number of interesting purchases amounting to about $275,000 were noted. Orders included a 6,000-kw. turbo-generator unit with control apparatus, costing about $160,000; switchboard and power control equipment, amounting to about $25,000, for mill expansion, and an order for power control, consisting of switchboards, regulators and accessories, amounting to $75,000. Small motor sales are increasing and are up in volume to those of last year. Transformer inquiries are active. Central-station requirements are receiving more attention and orders are steady, with line hardware, wire and poles in good demand.

An increase in appropriations for street lighting is noted throughout the district, appliance sales are steady and wiring contracts for mercantile type construction and institutions are in good volume. Charles H. Tenney & Company, Boston, Mass., plan a power plant on the waterfront at Salem, Mass., to cost in excess of $1,000,000.

Activities of the Trade

Jefferson Electric Combines With Chicago Fuse Company

Announcement was recently made of the consolidation of the Jefferson Electric Manufacturing Company and the Chicago Fuse Manufacturing Company. The new organization will be known as the Chicago-Jefferson Fuse & Electric Company, with offices at Laflin and Fifteenth Streets, Chicago. The following are officers of the new organization: President, J. A. Brennan, formerly president of the Jefferson Electric Manufacturing Company; vice-president, A. R. Johnson, formerly secretary of the Jefferson Electric Manufacturing Company; vice-president, A. E. Tregenza, formerly vice-president of the Chicago Fuse Manufacturing Company; treasurer, J. C. Daley, formerly treasurer of the Jefferson Electric Manufacturing Company.

Lincoln Opens New School for Instruction on Arc Welding

For many years a school of welding has been conducted by the Lincoln Electric Company, Cleveland, manufacturer of "Stable-Arc" welders, at its shop. The company recently entirely reorganized and re-equipped this school. Its purpose is the training of electric arc welders, no tuition or fees being charged. The course in the school occupies 30 days and is given in 12 lessons.

The pupils in the school work under the direction of a trained instructor, who teaches them both as a class and as individuals. All the educational work comes under the general direction of A. F. Davis, vice-president of the company. With 30 days intensive training, men are able to acquire a sound working knowledge of the fundamentals of electric arc welding and are fitted to engage competently in the trade. The company does not maintain an employment bureau for graduates of the course, but it does, if possible, fill such applications for men as are made to it from the school.

THE PETTINGELL-ANDREWS COMPANY, Boston, electrical jobber, announces that its name has been changed to the General Electric Supply Corporation. Frank S. Price, president, states that no change in ownership, organization or policy is involved.

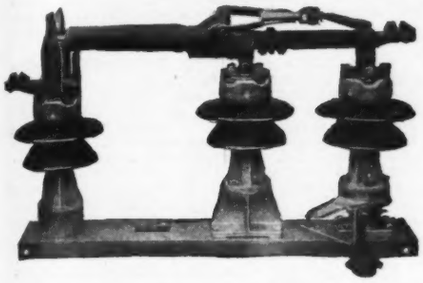
THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has received an order for the complete electrical equipment of the shipping board freighters "Defiance" and "Triumph" which will be converted to Diesel-electric drive.

THE GENERAL ELECTRIC COMPANY, refrigeration department, has appointed J. J. Donovan as apartment house specialist. Mr. Donovan was formerly territorial representative with headquarters at Pittsburgh, Pa.

New Equipment Available

Disconnecting Switch

The 37-kv., 2,000 amp., type TTR gang-operated "Hi-Pressure" contact disconnecting switch placed on the market by the Railway & Industrial Engineering Company, Greensburg, Pa., has the operating parts above the insulator of non-ferrous metals and is fitted with



37-kv., 2,000-amp. gang-operated "hi-pressure" contact disconnecting switch

monel metal bolts and pins at the vital points. The contact is made by rotating the blade into chrome steel reinforced jaws under pressure after the blade is operated into closed position. The rotating movement cleans the contact surface of corrosion and dirt. The pressure contact is released before the blade lifts, which the manufacturer claims makes its operation easy. The bearing on the rotating insulator column is equipped with Alemite lubrication.

Manual A.-C. Motor Starter

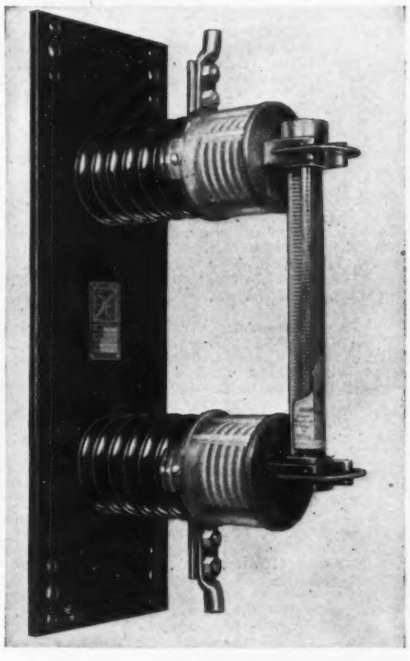
A manually operated starter for alternating-current motors up to 7½ hp., known as the C-H 9115, has been placed on the market by the Cutler-Hammer Manufacturing Company, Milwaukee. The switch mechanism incorporates the new C-H double-break roller contacts and wide-faced figures of heavy copper, cadmium plated. Thermal overload inverse time limit protection is provided. The mechanism of the starter is mounted on a "Thermoplax" panel, and knockouts are arranged on five sides of the box. The device has a two-part safety cover such that the lower part only can be opened for quick replacement of the fusible links in the overload cutouts, the upper part being arranged so that it can be locked if desired.

Inclosed Circuit Breaker Potheads

The "U-Re-Lite" manufactured by the Cutter Electric & Manufacturing Company, Nineteenth and Hamilton Streets, Philadelphia, is now available in increased capacities for 440-volt and 550-volt alternating-current service as follows: The "Junior" three-pole unit up to 80 amp., the "Senior" three-pole unit up to 200 amp., the type "W" three-pole unit up to 400 amp., and the type "LL" three-pole unit up to 1,000 amp. The company states that, interpreted in dollars, this means that many circuits formerly requiring a "Senior U-Re-Lite" can now be protected by a "Junior U-Re-Lite" and similarly in the cases of the other breakers mentioned above, at no sacrifice in positive protection, but at a saving in cost. The capacities given for the various types are load-carrying capacities. For interrupting capacities the company refers to tests made by two utility companies.

Potential Transformer Protective Combination

The type RR potential transformer protective combination has been placed on the market by Schweitzer & Conrad, Inc., Chicago. The equipment, as shown in the illustration, consists of combinations of a new current-limiting resistor and the type DLC ½-amp. fuse. The resistor has the S&C wire wound form of construction and is for indoor use only. The essential differences between this type of resistor and other

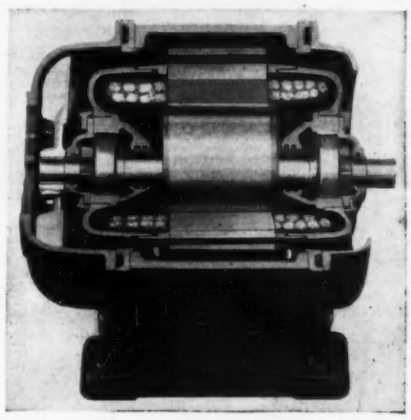


A protective combination for potential transformers

S&C resistors are that the type RR unit occupies a minimum of space and it may be applied, without alterations, to any existing indoor fuse mounting. This new design thus makes it possible to add a current-limiting resistor to any indoor fuse mounting now installed in a potential transformer application.

Totally Inclosed Motor

A new type of completely inclosed ventilated motor with a 40-deg. rating has been placed on the market by the American Electric Motor Company, Cedarburg, Wis., which recently became a subsidiary of the Splitdorf-Bethlehem Electrical Company of Newark, N. J. In describing this motor the company cites an unusual test to demonstrate how effectively dust is excluded from the windings. A glass case was



Cooling is accomplished by driving the air through as well as over the stator laminations

filled with a mixture of sand, iron fillings and sawdust until the motor was half covered. An external fan on the motor churned this mixture, filling the air with it and completely surrounding the motor with thick dust. For two weeks the motor was run under these extremely adverse conditions. When the motor was opened the windings were so clean that a permanent magnet brushed over them showed no trace of filings. Nor had any sand or sawdust penetrated the cover. The inclosed hoods hermetically seal the winding. The hoods are telescoped into a ring fastened to the stator laminations, the surfaces of which are machined.

The cooling of this type P-K motor is such that air is driven through as well as over the stator laminations. The stator core is perforated. Air in the inclosed portion is agitated by malleable cast fans shrunk on the motor shaft. The ball bearings are of the cage type. The inclosing hood of the motor can be removed without disturbing the bearing, which remains on its shaft inclosed in its cage. The stator is removable. Should it be damaged it can be replaced in a few minutes. The rotor has the end rings electrically welded to the bars.

POLYPHASE SWITCHES. — A line of polyphase switches built in sizes ranging from 60 amp. to 400 amp. with test connections and from 60 amp. to 600 amp. without test connections. These can be furnished with fuses sealable or accessible when the switch is in the "off" position. The switch is of slate base construction and the contacts are mounted on the top where they can be inspected in the "on" position.

Electrical Patents

Announced by U. S. Patent Office

(Issued Feb. 14, 1928)

1,659,293. ELECTRICAL DEVICE; W. Hermann, Chicago, Ill. App. filed Jan. 5, 1924. Electric igniters of the type employing a spring actuated drum and a cable which winds on the drum.

1,659,295. LATH SUPPORT AND LOOM FASTENER; P. P. Kaufman, Appleton, Wis. App. filed July 23, 1925.

1,659,303. CONNECTING BLOCK FOR ELECTRIC WIRING; L. H. Rovere, Richmond, N. Y. App. filed May 23, 1924.

1,659,312. MULTIPLE CONNECTER; R. C. Colwell, Morgantown, W. Va. App. filed Dec. 11, 1924. For connecting a plurality of electric wires to a battery terminal or the like.

1,659,400. ELECTRIC HEATER; J. M. Frank, Chicago, Ill. App. filed Jan. 21, 1924. Known as a grid heater.

1,659,421. ELECTRICAL CIGAR AND PIPE LIGHTER; C. D. Anderson, Ojus, Fla. App. filed March 29, 1927.

1,659,422. CLOCK; J. Bachtold, New York, N. Y. App. filed Nov. 23, 1926. Electromagnetic secondary clock.

1,659,429. INDUCTION ELECTRICITY METER; J. Harris, La Fayette, Ind. App. filed June 15, 1925.

1,659,447. ELECTRICAL ATTACHMENT PLUG; C. F. Smith, New Britain, Conn. App. filed March 18, 1926.

1,659,463. ELECTRICAL CONNECTER; T. B. Entz, Brooklyn, N. Y. App. filed Jan. 24, 1924. For connecting the terminals of storage batteries.

1,659,464. CURRENT CONNECTER; M. F. Fitzgerald, Winsted, Conn. App. filed July 24, 1924. For portable electrical devices such as flat irons, etc.

1,659,469. TRANSFORMER FOR ELECTRIC ARC CUTTING AND WELDING APPARATUS; F. C. Owen, Fayetteville, N. C. App. filed Nov. 14, 1925.

1,659,479. ELECTRIC HEATING UNIT OR ELEMENT; A. Brown, Gore, N. Z. App. filed March 23, 1923. For heating or boiling water in kettles, etc.

1,659,502. BURGLAR ALARM LOCK; W. J. Tyson, New York, N. Y. App. filed Dec. 4, 1925.

1,659,513. ELECTRICAL STEAM GENERATOR; C. B. Baughn, Visalia, Cal. App. filed Oct. 20, 1926.

1,659,515. METAL CLAD ELECTRIC SWITCH GEAR; H. W. Clothier, Wallsend-on-Tyne, and A. Allan, North Shields, England. App. filed April 21, 1925.

1,659,548. TRANSFORMER; S. E. Johannesen, Pittsfield, Mass. App. filed Sept. 8, 1926. A magnetic core and winding arrangement for transformers wherein those parts subjected to large differences of voltage are well separated and insulated.

1,659,549. ELECTRICAL MEASURING INSTRUMENT; I. F. Kinnard, Lynnfield, and W. H. Pratt, Lynn, Mass. App. filed July 12, 1926. Of the induction type for measuring characteristics of alternating current circuits such, for example, as the conductance.

1,659,550. METHOD OF AND FURNACE FOR UNITING METAL PARTS BY FUSION; C. Steenstrup, Schenectady, N. Y. App. filed May 29, 1926.

1,659,551. ELECTRIC COUPLER; H. E. Van Dorn, Chicago, Ill. App. filed May 9, 1921. For automatically coupling together a large number of train circuits on one railway car with those on an adjacent car.

(Issued Feb. 21, 1928)

1,659,561. ELECTRIC PERCOLATOR; W. S. Bremer, St. Louis, Mo. App. filed June 4, 1926.

1,659,576. CARBON HOLDER; G. D. Brady, Detroit, Mich. App. filed April 17, 1922. Adaptable for projection apparatus.

1,659,582. AUTOMATIC ELECTRIC CONTROL DEVICE; J. F. Wiggert, Lead, South Dakota. App. filed April 12, 1927. For automatically regulating pressure or the like.

1,659,606. SYNCHRONOSCOPE; K. H. May, Berlin, Germany. App. filed July 15, 1927. Employing an induction disc and induction field elements co-operating with the disc such that the apparatus may be largely constructed from standard meter parts.

1,659,614. WALL CIRCUIT BREAKER; F. W. Roller, East Orange, N. J. App. filed Sept. 25, 1924. Applicable to the formation of control panels for lighting and other circuits of rooms, offices, residences and the like.

1,659,619. PROTECTIVE ARRANGEMENT; O. C. Traver, Schenectady, N. Y. App. filed March 18, 1926. For systems comprising two parallel lines, especially when these are provided with a differential system of protection involving current transformers which are connected in series for normally circulating current, whereby further protection, such that either line alone may carry as much current as the two together, is provided.

1,659,623. DYNAMO-ELECTRIC MACHINE STATOR; J. M. Barr, Milwaukee, Wis. App. filed Dec. 12, 1923.

1,659,646. CIRCUIT-TESTING DEVICE; F. R. Weiss, Chicago, Ill. App. filed April 9, 1925.

1,659,648. ELECTRICAL FITTING; H. A. Douglas, Bronson, Mich. App. filed Jan. 27, 1926. For miniature lamp.

1,659,698. MASSAGE VIBRATOR; N. E. Norstrom, Chicago, Ill. App. filed June 22, 1922.

1,659,706. MEANS FOR SUPPRESSING HARMONICS OF THE TRANSMITTING LINE FREQUENCY; R. Rudenberg, Berlin-Grunewald, Germany. App. filed Aug. 25, 1926.

1,659,719. BLANKET WARMER; G. E. Blake, Fort William, Ontario, Can. App. filed April 18, 1927.

1,659,729. CONSTANT-VOLTAGE ALTERNATOR; D. K. Gannett, Jackson Heights, N. Y. App. filed Nov. 24, 1923. In which the output voltage will be substantially constant regardless of variations in the exciting voltage.

1,659,731. INSULATOR; E. I. Green, East Orange, N. J. App. filed July 1, 1925. Adapted to stabilize the leakage loss under different weather conditions.

1,659,749. ELECTRIC INCANDESCENT LAMP AND METHOD OF MANUFACTURING ITS ILLUMINATING BODY; F. Skaupy, Berlin, Germany. App. filed Dec. 2, 1921.

1,659,759. MOTOR CONTROLLER; T. E. Barnum, Milwaukee, Wis. App. filed May 17, 1920. Combined starting and low-current cutout controller for alternating current motors having different circuit connections for starting and running.

1,659,774. ELECTRIC HEATING DEVICE; W. W. Hicks, San Francisco, Calif. App. filed Jan. 5, 1925. Hot plate.

1,659,779. CURRENT-CONTROLLING DEVICE; T. J. Madigan, Brooklyn, N. Y. App. filed May 12, 1926. Automatic switch for electric heating devices such as flat irons.

1,659,862. THERMALLY-CONTROLLED ELECTRIC SNAP SWITCH; O. Dodge, Colorado Springs, Colo. App. filed Aug. 10, 1922. Cut-off mechanism for heated utensils.

1,659,864. SWITCH FOR ELECTRIC FLASH LIGHTS; R. M. Eaton, Niagara Falls, N. Y. App. filed Sept. 23, 1926.

1,659,897. REFLECTOR FOR RADIANT HEATERS; J. Schoenfeld, Alameda, Calif. App. filed April 6, 1925.

1,659,904. MEANS FOR REGULATING TRAFFIC; F. E. Woodford, Chicago, Ill. App. filed Sept. 14, 1922.

1,659,911. APPARATUS FOR PERFORMING SOLDERING OPERATIONS; J. W. Fay, Villa Park, Ill. App. filed June 13, 1924.

1,659,914. STOP ACTION FOR ORGANS; W. E. Haskell, Brattleboro, Vt. App. filed Feb. 7, 1923.

1,659,920. ELECTRIC WELDING PROCESS; T. E. Murray, Jr., Brooklyn, N. Y. App. filed Dec. 18, 1924. In which a steel tube is provided with a fin or flange of copper for use in boiler walls.

1,659,921. CLAMPING DEVICE; J. C. Nichols, Chicago, Ill. App. filed March 10, 1923. Which may be included in an electrical circuit and conduct current from the circuit to an article held by the device.

1,659,936. MOLDING COMPOSITION; H. F. Albright, Jr., Oak Park, Ill. App. filed Dec. 27, 1923. Comprising a compound composed of 8 per cent shellac, 21 per cent kauri gum, 55 per cent mica, and 16 per cent vermilion, and in addition a small quantity of rubber.

1,659,946. APPARATUS FOR HEAT TREATING ARTICLES; J. W. Fay, Villa Park, Ill. App. filed March 12, 1926.

1,659,951. LAMP SOCKET; J. Hohl, Newark, N. J. App. filed Dec. 5, 1922. Of cold moldable insulating material.

1,659,986. ELECTRIC STOVE; O. F. Baughman and L. W. Cady, Lakewood, Ohio. App. filed April 2, 1925.

1,660,017. SWITCH PLUG; J. Schoenfeld, Alameda, Calif. App. filed April 13, 1925.

1,660,041. FACIAL TREATMENT METHOD AND MEANS; W. Meyer, Chicago, Ill. App. filed June 12, 1925.

1,660,052. ELECTRIC HEATER; G. W. Shepherd, Terre Haute, Ind. App. filed Dec. 7, 1926.

1,660,070. FLOOR SWITCH; H. W. Crane, Chicago, Ill. App. filed Dec. 27, 1920.

1,660,080. RELAY FOR HIGH-TENSION FUSES; P. C. McKendrick, St. Paul, Minn. App. filed May 25, 1925.

New Trade Literature

MOTORS AND FIELD COILS.—Bulletins GEA-712A, GEA-918, GEA-919 and GEA-920 issued by the General Electric Company, Schenectady, N. Y., describe and illustrate respectively its type BTA adjustable speed, alternating-current, brush-shifting motors, the improved brush-holders for GE-73 and GE-240 railway motors and field coils with spring pads for GE-265 railway motors.

AUXILIARY EQUIPMENT.—The Cochrane Corporation, Seventeenth Street below Allegheny Avenue, Philadelphia, is distributing bulletin No. 676 covering apparatus for heating systems and industrial plants, including combined heaters and hot wells or storage tanks, deaerting heaters, steam and oil separators, traps, back pressure valves, filters and flow meters.

INCLOSED CIRCUIT BREAKER.—The Cutter Company, Nineteenth & Hamilton Streets, Philadelphia, has issued a supplement to its hand book of the "U-Re-Lite" covering larger capacity units of different types. Attention is also called to the multi coil U-Re-Lite, the separable contact U-Re-Lite and the extra long time-delay U-Re-Lite Included is data on short circuit tests made at the Hermitage Avenue station of the Commonwealth Edison Company of Chicago.

ELECTRIC APPLIANCES.—Catalog No. 3 issued by the Central Flatiron Manufacturing Company, Johnson City, N. Y., describes and illustrates the various "Betsy Ross" electric aids for the household and also includes a price list.

PROTECTIVE COMBINATIONS.—Bulletin AD1004 issued by Schweitzer & Conrad, Inc., 4421 Ravenswood Avenue, Chicago, describes and illustrates its type RR protective combinations for potential transformer applications in indoor locations.

STOKER.—A new publication issued by the American Engineering Company, Philadelphia, describes the Taylor coal-burning unit. A large drawing shows the Taylor unit driven by the Hele-Shaw rotary hydraulic motor.

OUTDOOR STATION EQUIPMENT, SWITCHES AND ELECTRIC FURNACES.—Bulletins GEA-505A, GEA-857, GEA-915, GEA-928, GEA-929 and GEA-930 issued by the General Electric Company, Schenectady, N. Y., describe and illustrate respectively its type TD-328 expulsion fusible cutout and disconnecting switch for short circuit protection and type EF-1 combined expulsion fuse and disconnecting switch for outdoor station equipment, the type E, form C expulsion type fusible primary cutout and disconnecting switch, the type LP-3 air break starting switches with round studs for synchronous converters, type LD-22 knife (lever) switches with laminated studs and the GE pot-type electric furnaces for lead hardening.

METAL AND NICKEL PRODUCTS.—The International Nickel Company, Inc., 67 Wall Street, New York City, has issued a fall 1927 buyers' guide on monel metal and pure nickel products.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

An agency is desired in Singapore, Straits Settlements (No. 29,908), for storage batteries for automobiles.

Purchase is desired in Barcelona, Spain (No. 29,978), of battery chargers and molds and separators for batteries.

An agency is desired in Turin, Italy (No. 29,981), for electrical apparatus.

An agency is desired in Caracas, Venezuela (No. 29,942), for household electrical appliances.

Purchase and agency are desired in Rome, Italy (No. 29,925), for high-voltage insulators, radio, telegraph and telephone apparatus and wiring supplies.

Purchase and agency are desired in Goteborg, Sweden (No. 29,926), for household electric refrigerators.